REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release or
Threatened Release of Hazardous Substances in Region 5

PREFINAL BASIS OF DESIGN REPORT
Old American Zinc Plant Superfund Site
Fairmont City, St. Clair County, Illinois
Facility Area Remedial Design
WA No. 224-RDRD-B5A1/Contract No. EP-S5-06-01

May 2018

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

ch2m

FOR OFFICIAL USE ONLY

PREFINAL BASIS OF DESIGN REPORT

Old American Zinc Plant Superfund Site Fairmont City, St. Clair County, Illinois

Facility Area Remedial Design
WA No. 224-RDRD-B5A1/Contract No. EP-S5-06-01

Prepared for

May 2018

Contents

Appendixes

Tables

Figures

Acronyms and Abbreviations

ARAR	applicable or relevant and appropriate requirement
BODR	basis of design report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CH	fat clay (soil classification)
CH2M	CH2M HILL, Inc.
COC	contaminant of concern
CQAP	construction quality assurance plan
EPA	U.S. Environmental Protection Agency
FA	facility area
FS	feasibility study
IAC	Illinois Administrative Code
NC	normally consolidated (soil classification)
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
OAZ	Old American Zinc
OC	overconsolidated (soil classification)
PRP	potentially responsible party
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
ROD	Record of Decision
SWPPP	stormwater pollution prevention plan
SPT	standard penetration test
TCRA	time-critical removal action
XTRA	XTRA Intermodal, Inc.

SECTION 1

Introduction

The U.S. Environmental Protection Agency (EPA) contracted CH2M HILL, Inc. (CH2M) to prepare the remedial design (RD) for the Facility Area (FA) at the Old American Zinc (OAZ) Plant Superfund Site, consistent with the Record of Decision (ROD) (EPA 2012). This prefinal basis of design report (BODR) was prepared to address contaminated soil at the FA and soil received from offsite properties surrounding the FA. The work will be completed in accordance with Work Assignment No. 224-RDRD-B5A1 under Contract No. EP-S5-06-01. The work will be completed in accordance with the *Old American Zinc Plant Superfund Site, Fairmont City, St. Clair County, Illinois, Remedial Design Work Plan* (CH2M 2017), the ROD (EPA 2012), and the *Remedial Design/Remedial Action Handbook* (EPA 1995).

1.1 Site Description

The OAZ Superfund Site is located in the Village of Fairmont City in St. Clair County, Illinois. The site includes a 132-acre FA and surrounding properties (Figure 1-1) where elevated metal concentrations associated with the facility operation were found in different media. The FA is bordered by several commercial and industrial properties, including Garcia Trucking to the west, CSX Intermodal railroad yard to the south, and General Chemicals to the east. Rose Creek is an ephemeral creek present at the southern boundary of the site. A portion of the site is within the 100-year floodplain (Figure 1-2). Figure 1-2 also shows several drainage ditches that are present onsite, along with Rose Creek.

1.2 Site History

OAZ conducted zinc-smelting operations at the site from 1916 to 1967. Slag from the smelting operation was cooled by placing the molten material along the northern and western boundary of the FA. The slag stock piles originally encompassed an area of 15 acres. The site, including the clinker and other smelting residues on the property, was purchased by XTRA Intermodal, Inc. (XTRA), in 1979. XTRA operated a trucking terminal at the site until 2003 that included lease, storage, and maintenance of a diverse fleet of trailers. XTRA ground and redistributed the slag stockpiles on the FA to buildup and level the former plant site to facilitate its trucking operation. At present, redistributed slag on the FA cover an area of 125 acres with thickness ranging from 6 inches to 9 feet (ENTACT 2012).

Site investigations conducted at the site since 1994 detail the nature and extent of contamination in the FA and surrounding properties. ENTACT completed a remedial investigation (RI) and feasibility study (FS) for the site in 2012 and identified contaminants in different media that included slag stock piles, ground slag that was used as fill material, high metal concentrations in shallow groundwater in the FA, and small localized instances of tar-like materials (tarry material) assumed to be residual products historically used at the FA, including asphaltic tars or asphaltic grouts commonly used in brick structures exposed to high heat.

The impacted surrounding areas include residential, commercial, and vacant properties and village alleyways and drainageways that were contaminated with runoff from the facility. Ground slag was also transported to offsite properties by local businesses, residents, and the Village for surfacing village alleyways and used as fill material in residential properties (ENTACT 2012). Most of the impacted properties are located to the west of the site, with small pockets of trailer park and residential developments to the north, south, and east.

EPA, under the provisions of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), conducted a time-critical removal action (TCRA) from 2002 to 2003. A total of 462 offsite properties was sampled during the TCRA, of which 209 properties were found to have lead concentrations above the Remedial Action Level of 400 parts per million. Impacted soil was removed from 152 properties, with the remaining properties to be addressed under future remedial action (RA). Following the completion of the RI/FS in 2012, a ROD was issued by EPA detailing the selected remedial approach for the site. EPA entered into an Administrative Order on Consent with the potentially responsible party (PRP) in August 2014 to perform the RD work. The PRP was tasked with performing the RD work, and a draft final RD report (consisting of the report, selected drawings, but no technical specifications) was submitted to EPA in April 2016. In April 2016, the entity responsible for the PRP's work filed for Chapter 11 bankruptcy and ceased performing additional work at the site. As a result, EPA took control of the site to complete the RD.

CH2M previously performed oversight at the OAZ site on behalf of the EPA and has been tasked with completing the RD activities under WA No. 224-ROBE-B5A1.

1.3 Selected Remedy and Remedial Action Objectives

EPA's selected remedy for the site is Alternative 4A, as described in the ROD (EPA 2012). The overall strategy for the site is to contain and cover the low-level-threat waste in order to reduce future human health and ecological risk to acceptable levels.

The selected remedy for the FA involves removal of vitrified slag, redistributed ground slag, and affected soils and sediments within the FA, removal of source material (slag used as fill) and placing within a 35-acre consolidation area located in the southwest portion of the FA. Contaminated soil from the identified residential, commercial/industrial, vacant properties, or village alleyways above the applicable residential or commercial/industrial human health cleanup levels (Operable Unit 2) will also be placed in the consolidation area. Tarry material will be placed in the consolidation area, unless it is deemed to be characteristically hazardous. Tarry material that is hazardous will be sent for offsite disposal at a Resource Conservation and Recovery Act (RCRA)-permitted Subtitle C facility approved under the EPA Off-Site Rule. The consolidation area will be capped with a cover system consisting of a 24-inch low-permeability clay barrier, overlain by a 12-inch vegetative soil cover. An Environmental Covenant will be placed on the groundwater and soil as an institutional control.

Remedial action objectives (RAOs) were created for source materials, affected soil/sediment, and for groundwater both on the FA and surrounding properties. For each media, the RAOs were designed to address potential human health and environmental risks with direct exposure to contaminants of concern (COCs) in media. RAOs are presented in their entirety in Section 2.8 of the ROD (EPA 2012).

1.4 Remedial Design Activities

RD activities to support implementation of the selected remedy have been outlined in EPA's Statement of Work dated December 14, 2016, attached to the Initial Work Assignment Form, dated December 21, 2016. The activities included in the design include the following:

- Project Management and Reporting
- Subcontractor Procurement and Support Activities
- Prefinal/Final design
- Technical and Post-RD support

Project management, community involvement, and post-RD support are efforts that are required to manage the work and support EPA in related activities.

The following appendixes are included in this report:

A Slope Stability Calculations
B Stormwater Design Calculations
C Old American Zinc Facility Area Design Specifications
D Construction Quality Assurance Plan

E Operations and Maintenance Plan
F Engineer's Estimate of Construction Cost
G Drawings

CH2M will provide general technical support for the site during the RA/construction phase, as stated in the *Remedial Design Work Plan* (CH2M 2017).

SECTION 2

Project Delivery Strategy

Section 2 presents the project delivery strategy for the remediation at the FA. The RA consists of excavating slag and source material from the FA and placing excavated material into a newly constructed consolidation area. The consolidation area will be capped with a cover system consisting of a 24-inch low-permeability clay barrier, overlain by a 12-inch vegetative soil cover.

2.1 Remedial Design

Implementation of the RA will consist of several components, including general activities for the project, and property-specific activities. Although some of the components will occur concurrently, the general sequencing of the primary components will be as follows:

- Procurement.
- Preconstruction activities.
- Mobilization.
- Site preparation and surveying.
- Excavation of source material from the footprint of the new consolidation area to be constructed. Stockpile excavated source material in the northwest portion of the site adjacent to the existing slag stockpile as shown in Figure 2-1.
- Excavation of source material in the northeast and southeast portions of the site to create stockpile areas for clay for the cover and general site fill. Stockpile excavated source material in the northwest portion of the site adjacent to the existing slag stockpile as shown in Figure 2-1.
- Excavation of unimpacted clay from the consolidation area to design grades, and placement of the clay in stockpile areas in the northeast and southeast portions of the site. Clay meeting the requirements of the low-permeability cover shall be placed in the clay stockpile in the southeast portion of the site. Material to be used for general site fill shall be placed in the general fill stockpile in the northeast portion of the site. The general fill stockpile may consist of clay meeting the low-permeability requirements in addition to other materials encountered.
- Excavation of source material from the FA and placement of material into the consolidation area, along with previously stockpiled material, and excavated soil from surrounding properties.
- Covering the consolidation area with low-permeability cover and vegetative layer.
- Grading, including filling and cutting, FA to design grades using stockpiled clay.
- Site restoration.
- Demobilization.

Detailed drawings (Appendix G) and specifications (Appendix C) have been prepared as part of the RD. As part of the RA activities, the RA contractor will be required to present a detailed work plan to the owner's representative describing how the work will be executed.

2.2 Remedial Action

Roles during the RA will be defined as follows:

- Owner: EPA, Region 5
- Engineer: CH2M
- Property Owner: XTRA Intramodal
- Owner’s Representative: construction management firm, or U.S. Army Corps of Engineers, which the EPA has contracted to complete the RA
- RA Contractor (contractor): Responsible for completing work described in the contract documents, and management of all subcontractors
- Subcontractor: A subcontractor retained by the contractor

The procurement strategy for implementing the RA includes planning, contractor prequalification, submittal of a Request for Proposals, evaluation of the proposals, submittal of the Request for Consent, contract award, and contract management.

Some of the design specifications for the project may be performance-based. This type of contract allows the contractor the flexibility to provide innovative and cost-effective solutions to the project. To provide prospective contractors with sufficient time to review the existing data and develop their proposals, the solicitation process will begin following approval of the final design document.

2.3 Procurement Activities

The owner’s representative will solicit separate contracts for select components of the RA. The components include, but are not limited to, earthwork, surveying, and restoration under a single contract, to be performed by the primary contractor (hereinafter referred to as contractor). Although the contractor may choose to subcontract portions of the project, in this document “contractor” will refer to the primary RA contractor.

Procurement of contractors will be completed prior to commencing construction activities. Contractors for the RA activities are expected to be competitively procured, and procurement activities for the surrounding properties will be independent of any procurement activities for the FA.

Contracts will be competitively bid among qualified businesses that are able to meet the technical, safety, and schedule requirements. Under the RA, potential bidders will be prequalified from various sources, including a diverse supplier database and the EPA Region 5 Small and Disadvantaged Business Utilization Coordinator.

The solicitation documents will include instructions to bidders, project specifications, drawings, proposed contract agreement (including EPA Prime Contract flow-down provisions), and other forms for bidders to complete. Proposals will be evaluated, and award(s) will be made to the successful bidder(s).

SECTION 3

Basis of Design

Section 3 presents the technical details and assumptions of the RD.

3.1 Subcontracting

Procurement of subcontractors will be completed prior to commencing construction activities. Subcontractors for the RA activities are expected to be competitively procured among qualified businesses that are able to meet the technical, safety, and schedule requirements, and subcontracts are independent of any RA activities to be performed for the surrounding properties.

3.2 Preconstruction

Preconstruction work includes preparation of site plans and other submittals, identification of clean borrow sources for topsoil, and coordination with St. Clair County and affected utility companies. The work will be conducted prior to contractor mobilization.

3.2.1 Design Assumptions

3.2.1.1 Site-specific Plans and Preconstruction Submittals

CH2M has drafted a construction quality assurance plan (CQAP; Appendix D) which provides detailed guidance for implementation of quality processes and procedures during construction operations. A site-specific health and safety plan will be prepared and provided under separate cover. The health and safety plan will outline procedures to be followed so that the work is completed safely and with no adverse health effects to workers or the community.

A draft stormwater pollution prevention plan (SWPPP) will be prepared and provided by the earthwork subcontractor with information specific to their approach during the RA as a means to describe the potential sources of stormwater pollution at the site, describe practices to reduce pollutants in stormwater discharges from the site, and identify procedures they will implement to comply with the substantive requirements of Illinois General National Pollutant Discharge Elimination System (NPDES) Permit for Stormwater Discharge from Construction Site Activities (Illinois General NPDES permit; Illinois Environmental Protection Agency 2014). Substantive requirements of Illinois General NPDES Permit will be adhered to, including inspections by a qualified person (that is, Professional Engineer, Certified Professional in Erosion and Sediment Control, Certified Erosion Sediment and Stormwater Inspector, or other knowledgeable person) who possess the skills to assess conditions at construction sites that could impact stormwater quality and assess effectiveness of any sediment and erosion control measures implemented. The qualifications of the qualified person will be in accordance with the requirements of Illinois General NPDES Permit and 40 *Code of Federal Regulations* Parts 121 and 122.

The contractor will verify compliance with the substantive requirements of applicable regulations. The subcontractor will also deliver applicable preconstruction submittals to CH2M for approval before mobilization. Preconstruction submittals include site-specific plans (including waste management plan, erosion and sedimentation control plan, and a dust control and monitoring plan), a detailed project schedule, and identification of source materials as required in the specifications (Appendix C) and identified in the CQAP (Appendix D).

3.2.1.2 Staging Area

The staging area will be located in the northwest portion of the FA with the approval of EPA. The property owner will be notified of the staging area location prior to EPA approval. The FA is secured with fencing and has adequate area to store equipment, house temporary field offices/trailers, and equipment decontamination facilities.

3.3 Initial Mobilization

Initial mobilization includes that of the contractor. Design assumptions are discussed in the following subsections.

3.3.1 Design Assumptions: Contractor Mobilization

Initial mobilization will consist of the following, as needed:

- Constructing temporary facilities such as field office/trailers, material storage facilities, and equipment decontamination facilities
- Placing stabilized construction entrance material at the construction entrance
- Placing gravel at storage, laydown, and staging areas for erosion and sediment control, and if necessary, for grade in designated areas
- Delivering equipment
- Placing erosion and sediment control features, such as silt fencing, for stockpile and staging areas
- Documenting any measures necessary to comply with location-specific applicable or relevant and appropriate requirements (ARARs) such as the Migratory Bird Treaty Act
- Documenting the condition of the FA and haul route with pictures

Equipment to be used by contractors are expected to be transported by road. The contractor will provide and maintain required temporary facilities for the duration of the project, along with a field office/trailer.

Temporary utilities will be active for the duration of the project, plus an additional 1 week at the start and end of construction.

3.3.2 Design Assumptions: Site Security and Coordination

The FA, which is fenced, will be used as a staging area for the storage of equipment, stockpiling borrow material, staging excavated source material, decontamination facilities, and temporary field offices/trailers. A decontamination pad will be constructed for equipment decontamination.
The contractor will be responsible for security to monitor site equipment and the staging area during non-working hours. The contractor will maintain control over work areas during working hours at the site.

3.4 Site Preparation

Site preparation activities specific to the FA include installing erosion and sediment control measures, and locating utilities.

3.4.1 Design Assumptions

3.4.1.1 Preconstruction Survey

A preconstruction survey will be performed to document existing surface elevation and conditions, and will be used during excavation and construction. A post-reclamation survey will be performed after remediation to document the final conditions. Surveys will be conducted by an Illinois-licensed surveyor.

3.4.1.2 Utility Locate

The one-call utility location system (JULIE) will be contacted and a third-party utility-locating service used to identify utilities within the FA before work begins. During the preconstruction property visit, the property owner will be interviewed to determine if there are any undocumented or private utilities on the property. The location of property-owner-identified utilities shall be confirmed using a third-party utility-locating service and other physical means at the property. The actual location of the utilities will be recorded on the property drawing for permanent documentation.

3.4.1.3 Clearing and Grubbing

Clearing, grubbing, and removal of any structures that may provide migratory bird habitat will be performed no earlier than August 1 (end of bird breeding season), where necessary, at the FA. Details for the clearing and grubbing are provided in the project specifications.

3.4.1.4 Temporary Erosion, Sediment, and Nuisance Controls

Temporary erosion and sediment controls to minimize the transport of contaminated surface soils offsite include temporary erosion control matting, silt fence, compost filter socks, and straw applications. The erosion and sediment controls will be constructed, inspected, and repaired or replaced as necessary during construction. This design contains proposed components to address erosion and sediment control, as shown in the drawings (Appendix G). In addition, a SWPPP is a contractor-required submittal prior to construction.

3.4.1.5 Temporary Slopes

Temporary slopes may be created during the construction of the cover for the subgrade and compacted clay soil layers. Temporary stockpile areas created for placing excavated soils will have slopes that will require maintenance and erosion protection. The temporary slopes will be required to be maintained during construction and placement of the cover layers to minimize erosion. Imported material will be required to be certified clean and meet 35 Illinois Administrative Code (IAC) 1100, Subpart F.

3.4.1.6 Sediment Barriers

Silt fences will be used to impede the flow and to provide for solids removal to reduce the transport of the sediment. These controls will be placed along the contours on long slopes and at the perimeters of the disturbance area, in places where temporary diversion berms cannot be used. Silt fence will be installed as shown on the drawings. Silt fence (or compost filter socks) will be installed at the base of consolidation area slope and at the top of temporary drainage ditch banks to prevent sediments from non-vegetated surfaces from migrating into temporary ditches. Silt fences will be maintained until site restoration is complete or until grading measures have removed their need. Erosion and sediment controls will follow the requirements and best management practices in the Illinois Urban Manual.

3.4.1.7 Stabilized Construction Entrances

The stabilized construction entrances will consist of stabilized stone underlain with a geotextile fabric to reduce the amount of soil removed from the construction site. The entrance will be repaired as necessary to maintain its effectiveness throughout the project.

3.4.1.8 Dust Control and Monitoring

Dust control will be provided during excavation, consolidation, and soil cover construction activities to meet the substantive requirements of the fugitive particulate matter ARARs. Water for dust control may come from the onsite ponds, the municipal water system, or other local sources. An air monitoring plan, which includes perimeter air monitoring for site COCs, is required prior to construction.

3.4.1.9 Noise Control

Equipment that complies with 35 IAC part 900 standards for noise will be provided, and daytime and nighttime noise levels at the site property line will be complied with to the extent practicable. If noise complaints occur, adjustments to the work schedule or operations will be developed thereafter.

3.4.1.10 Permanent Erosion and Sediment Controls

Permanent erosion and sediment controls include established vegetation in ditches. Permanent vegetative cover will be used on the final at-grade soil surfaces. Soils will be seeded with native seed mixtures, depending on the temperature at time of planting. The final cover itself allows stormwater to drain to designed drainage structures.

3.5 Consolidation Area Construction

The descriptions of the steps necessary for the construction of the consolidation area are provided in the following subsections.

3.5.1 Description of Work

Excavation, transporting, stockpiling, grading, and compaction will be performed. Completion of excavation activities will require excavation of both slag and native clay by mechanical methods. The placement of the consolidation area is such that it will remain out of the 100-year floodplain as shown in Figure 3-1.

3.5.2 Design Assumptions

3.5.2.1 Estimation of Quantities

For estimation of quantities, geotechnical borings were advanced throughout the FA to determine slag and clay thickness. The depths of slag and clay were then interpolated between the boring locations, and an estimated required slab excavation quantity was determined using computer-aided design (CAD) software. Additional volume calculations were performed in CAD to determine the following quantities in cubic yards.

- Existing slag stockpile on site: 33,414 cubic yards
- Slag excavated from consolidation area footprint: 234,695 cubic yards
- Slag excavated from general fill stockpile footprint: 15,212 cubic yards
- Slag excavated from clay stockpile footprint: 1,345 cubic yards
- Contaminated soil from offsite residential properties: 15,000 cubic yards (assumed)
- Slag excavated from remainder of site (not including consolidation area or stockpile area footprints: 480,274 cubic yards
- Consolidation Area design capacity: 970,000 cubic yards
- Clay excavated to construct consolidation area: 375,780 cubic yards
- Clay fill needed for low-permeability cover: 112,368 cubic yards
- Clay Fill needed for site restoration: 263,534 cubic yards
- Topsoil needed: 227,226 cubic yards

3.5.2.2 Surface Preparation

Preparation within the footprint of the consolidation area will be performed by mechanically excavating surficial slag to an extent such that the compacted soil cover layer can be terminated on clean, stable soil. It may be necessary to over-excavate and backfill with general fill to accomplish this. The surficial slag will be removed from the footprint to allow excavation of the entire cell floor to an elevation of 410 feet. Localized grading will be performed by the Contractor to allow for proper drainage during construction.

Surface preparation is also required in areas that will be used for stockpiling the clay that will be excavated from the consolidation area. These stockpile areas are in the northeastern and southeastern portions as shown in Figure 2-1. The excavated slag will be stockpiled in the northwest portion of the FA on or adjacent to the existing slag stockpile.

The contractor will perform post-excavation confirmatory sampling and visual observations to verify that all surficial slag has been removed and that the underlying clay has not been impacted. Analytical testing will be performed on a grid with 100-foot centers within the bottom of the excavation, and for every 100 linear feet of sidewall.

If concrete foundations are encountered during excavations, the concrete will be completely removed, pulverized, and placed in the stockpile along with the surficial slag.

Dust abatement will be performed during excavation and transportation operations as necessary to prevent emission of visible fugitive dust beyond the FA boundary. Activities may include a work stoppage until dust abatement measures are implemented.

3.5.2.3 Stockpile Areas

Excavated slag from the FA will be placed on and adjacent to the existing slag stockpile in the northwest portion of the site. Material that is excavated from the consolidation area will be stockpiled in two areas based on the intended use. Clay that will be used to cover the consolidation area will be placed in the clay stockpile in the southeastern portion of the site. Material that will be used as general site fill will be placed in the general fill stockpile in the northeastern portion of the site. The locations of the proposed stockpiles are shown in Figure 2-1 and in the drawings (Appendix G).

Excavated contaminated soils from adjacent properties will be placed adjacent to the existing slag stockpile in the northwest portion of the site, meeting the design requirements of Title 35 IAC 724.654, and covered daily. All stockpiles will be inspected and maintained by EPA until used onsite.

The contractor will identify potential borrow sources of topsoil in their proposal within 5 days of Notice of Award. Prior to receiving the materials, the contractor will collect compliance samples of these materials and submit the samples to the for testing to verify that the material meets specifications and is appropriate for use. Continued compliance samples will be collected and submitted for laboratory analysis as identified in the specifications throughout the RA.

3.5.2.4 Tarry Material

Tarry material may be present mixed with demolition debris and in localized areas across the footprints of former smelter buildings. Tarry materials that are encountered will be analyzed to determine if they are characteristically hazardous. If they are not, the materials will be put into the consolidation area. Characteristically hazardous tarry material will be appropriately managed onsite as hazardous waste, and sent offsite for disposal at a permitted RCRA Subtitle C disposal facility approved under the Off-Site Rule.

3.5.2.5 Concrete Foundations

Several concrete foundations are present onsite, remaining from the former smelter buildings.
The foundations will be exposed during excavation of the surficial slag, and when encountered, they will

be completely removed, pulverized, and will either be stockpiled with the slag in the northwestern portion of the site or placed directly into the consolidation area (after it is excavated).

3.5.2.6 Consolidation Area Subgrade Preparation

After completion of the slag excavation in the consolidation area footprint, the underlying native clay will be excavated as shown in the drawings to construct the bottom of the consolidation area. The approximate bottom elevation will be 410 feet. The subgrade will be compacted and proof rolled, and any remaining unsuitable soils below this elevation will be removed and replaced with suitable compacted fill. The excavated clay will be used use as the low-permeability cover system and for general site fill as discussed in Section 3.2.1.3.

3.5.2.7 Placement of Slag Material

Surficial slag will be excavated from the remainder of the FA not already excavated and will be placed within the consolidation area along with stockpiled slag and contaminated material from the adjacent residential properties. The material will be placed in layers and compacted as described in the specifications (Appendix C). The material will be graded as shown in the drawings (Appendix G).

3.5.2.8 Compacted Low-Permeability Cover Layer

A minimum 24-inch compacted low-permeability soil cover layer will be constructed on top of the prepared slag material. Geotechnical testing on clay obtained from the site indicates that the native clay is a suitable material for this purpose. Excavated clay from the consolidation area footprint meeting this criterion (as indicated by index testing) will be used for the cover. Any clay that does not meet the permeability criteria shall be used for site restoration as discussed in Section 3.5.2.11.

The layer will be placed and compacted as described in the specifications (Appendix C). The compacted soil cover layer will be constructed to the design grades shown in the drawings (Appendix G).

3.5.2.9 Vegetative Soil Layer

Twelve inches of topsoil cover will overlay the compacted clay layer. The topsoil will be seeded and maintained to establish a vegetative cover as discussed in Section 3.6.

3.5.2.10 Slopes

The slopes shown in the final cover grading plans are based on 4 to 1 (horizontal to vertical) slopes on the perimeter berms and a 3 percent slope on top of the cover. The final design slopes may be adjusted up or down to accommodate more or less waste quantity. Any changes to the consolidation area slopes shall be verified and approved by the engineer.

3.5.2.11 Site Restoration

After the low-permeability cover is placed over the consolidation area and the entire site has been cleared of slag material, the existing grades will be leveled (where needed) in preparation for the placement of general site fill. The material from the general fill stockpile in the northern portion of the site will be used to backfill to the design grades as shown in the drawings (Appendix G).

A 12-inch-thick layer of topsoil will be placed over the entire site, including the consolidation, and will be restored as described in Section 3.6.

3.5.2.12 Material Balance

The consolidation area as designed can accommodate approximately 974,000 cubic yards, and will contain all of the material from the site (stockpiled and surficial slag), in addition to contaminated soil removed from the adjacent residential sites. The clay excavated in order to create the consolidation area will be stockpiled onsite as previously discussed and will be used completely in the restoration. As a result, there will be a net balance of materials, both slag and clay, onsite. Quantities of materials are discussed in Section 3.5.2.1 and are provided in the cost estimate in Appendix F.

The final design for the cell may be adjusted to allow for additional waste, or it may be modified to accommodate a lesser volume of wastes.

3.5.2.13 Air Monitoring

Real-time air monitoring for particulate matter will be conducted continuously at the FA while earthwork is being performed. Data will be recorded to a data logger once per minute and checked by personnel once per 30 minutes, in accordance with the CQAP (Appendix D). The air monitoring equipment will be placed at locations to verify effectiveness of engineering controls in minimizing dust generation that may potentially leave the exclusion zone. Dust monitors will be placed by the contractor to determine the impact of the construction activities on air quality. One monitoring station shall be placed upwind, and three shall be placed downwind of earthwork activities at the FA, and locations shall be updated daily based on the activities performed and the predominant wind direction.

Dust-monitoring data will be evaluated against the EPA National Ambient Air Quality Standards for PM_{10} of 1.5 milligrams per cubic meter. The standards are based on a 24-hour average, but active construction activities will only be performed for approximately 10 to 11 hours per day, so no dust generation is assumed during the non-working hours. During work hours, an alarm will be set at 0.75 milligrams per cubic meter to observe activities and determine the cause for elevated particulate concentrations and to evaluate potential mitigation measures to maintain the 24-hour average concentration below the criteria. Exceedances of the dust-monitoring criteria require dust abatement measures, typically application of water, or stop work and further evaluation.

Personal air sampling pumps will be used in conjunction with dust-monitoring equipment and will have samples collected for laboratory analysis to determine potential exposure to arsenic and/or lead. These samples will be representative of the worst-case exposure that may occur to any potential receptors outside of the excavation area, such as residents or pedestrians, from the excavation work. Based on the results of the first week of personal air sampling, the sampling plan will be reviewed to evaluate the monitoring program for the remainder of the field event. Factors that will be considered include, but are not limited to, the following: (1) results of the first round of personal air sampling, (2) level of soil contamination anticipated in future excavations based on previous soil sampling data, (3) soil conditions (wetness) anticipated, and (4) level of work activity anticipated.

3.5.3 Design Evaluations

Several design components are necessary to ensure the longevity of the consolidation area, including slope stability, settlement, soil loss, and stormwater calculations. The following subsections describe the individual calculations in detail and provide the results of the analyses.

3.5.3.1 Consolidation Area Stability and Settlement Analysis

The consolidation area berm and cover system was analyzed for global stability using SLIDE version 7.0 by RocScience. SLIDE is a two-dimensional limit equilibrium slope stability program for evaluating the factors of safety against slope failure. Rotational (circular) and translational (block and non-circular) surfaces were evaluated using the Spencer method. Drained and undrained static, seismic (pseudostatic), and post-seismic conditions were evaluated.

Seismic (pseudostatic) analyses were performed using a conservative pseudostatic coefficient (k_h) of 50 percent of the peak ground acceleration for the 2,475-year return period earthquake (U.S. Geological Survey 2018). Strength-reduction factors were used for the pseudostatic and post-seismic analyses.

The cross section for analysis was selected along the southeast edge of the proposed area, which represents the maximum cell height and conservatively assumes that the perimeter ditch is at the toe of slope.

The calculated factors of safety for static, seismic (pseudostatic), and post-seismic were compared to a minimum factor of safety criteria of 1.5, 1.0, and 1.3, respectively, consistent with Illinois Environmental Protection Agency and EPA guidance. See Appendix A for stability analysis details and results.

Subsurface Conditions and Soil Properties

Limited geotechnical strength data are available for the proposed cell footprint, although general soil types and stratigraphy have been documented by previous borings and monitoring wells. Therefore, reasonably conservative drained and undrained soil properties were assumed, based on typical values for similar materials.

In March of 2009, ENTACT prepared an investigation report (ENTACT 2009), documenting an environmental field investigation performed between 2006 and 2008. One-hundred and twenty geoprobe borings between 4 to 16 feet deep, 7 hand auger borings between 3.5 to 6 feet, 10 wells between 16 to 24 feet deep, and 3 hollow stem auger borings up to 76 feet deep were used to prepare the stratigraphy within the facility.

The subsurface shown in Section A-A of the ENTACT investigation report (ENTACT 2009) consists of the following (from top to bottom):

- 4 to 8 feet of slag
- Approximately 15 feet of fat clay, silty clay, and clayey silt
- 10 to 20 feet of silt, sand, and mud
- 30 to 35 feet of fine sand and silt
- Fine to coarse sand

Based on monitoring well data, it is anticipated that the water table is about elevation 405. For analysis purposes, the water table was considered at 415, near the bottom of the proposed perimeter ditch.

Geotechnical strength and consistency data in the ENTACT investigation report (ENTACT 2009) is limited to two borings with standard penetration test blowcounts (SPT N-values) reported for silt and sand below 20 feet below ground surface. These data indicate the deep silt and sand are medium dense (with SPT N greater than 20), but other soil boring log descriptions indicate that the shallower silt and sand could be in a looser condition. Index tests performed on clay samples from test pits indicate that fat clay (Unified Soil Classification System classification of CH) are common at the site.

Table 3-1 summarizes the selected geotechnical parameters for slope stability evaluations. Due to the limited amount of geotechnical strength and consistency data, conservative strength parameters were selected for the stability analyses. As discussed in more detail below, testing is recommended prior to consolidation area construction to confirm these parameters.

For seismic (pseudostatic) analyses, an undrained shear strength of 80 percent of the assumed static (peak) shear strength was assigned.

For post-seismic analyses, an undrained shear strength of 65 percent of the static (peak) shear strength was assigned for cohesive soils. For the saturated, potentially loose shallow silts and sands, a post-seismic shear strength ratio (Su/P’) of 0.1 was conservatively assumed to account for the potential “worst-case” of liquefaction of this layer. For unsaturated or denser granular materials (compacted residuals and medium dense foundation sands), 80 percent of the static (peak) strength was assigned.

Table 3-1 lists soil parameters used in the global stability analyses.

Table 3-1. Geotechnical Engineering Strength Parameters by Stratum
Old American Zinc Superfund Site Facility Area

Stratum	Description	Moist Unit Weight	Assumed Shear Strength Parameters								
			Static			Pseudostatic			Post-Seismic Residual		
		γ_m	c'	ϕ'	S_u	c'	ϕ'	S_u	c'	ϕ'	S_u
		(pcf)	(psf)	(deg)	(psf)	(psf)	(deg)	(psf)	(psf)	(deg)	(psf)
Ia	Fill - Top Soil - Stiff	130	0	25	1,500	--	--	0.8x S_u	--	--	0.65 x S_u
Ib	Fill – Slag and Residuals	120	0	23	(drained)	0	18.8	(drained)	0	18.8	(drained)
Ic	Fill - Clay - Stiff	128	0	29	1,000	--	--	0.8x S_u	--	--	0.65 x S_u
IIa	Native - Clay - Stiff	128	50	29	1,000	--	--	0.8x S_u	--	--	0.65 x S_u
IIb	Native - Silt - V. Loose	115	0	24	(drained)	0	19.6	(drained)	--	--	$S_u/\sigma_v'=0.1$
IIc	Native - Sand - M. Dense	125	0	29	(drained)	0	23.9	(drained)	0	23.9	(drained)

Notes:
γ_m = moist unit weight
c' = effective cohesion
ϕ' =effective friction angle
S_u = undrained shear strength
σ_v' = effective vertical stress
deg = degree
pcf = pounds per cubic foot
psf = pounds per square foot

Results and Design Recommendations

Table 3-2 summarizes the resulting global stability factors of safety. Appendix A contains full results, including the SLIDE profiles. As shown in Table 3-2, all analyses satisfy the minimum factor of safety criteria based on the assigned soil strength parameters in Table 3-1.

While the assigned soil strength parameters are considered reasonably conservative for similar soils, limited geotechnical strength or consistency data is available within the cell footprint. Therefore, verification testing is recommended within the proposed cell footprint to confirm that the soil parameters in Table 3-1 are representative. This could be done by a grid of cone penetration test soundings around the perimeter of the proposed cell berm, possibly combined with a few samples collected for geotechnical analysis (index, strength, and consolidation tests).

Table 3-2. Factor of Safety – Global Stability Analyses
Old American Zinc Superfund Site Facility Area

Case	Shape of Slip surface	Factor of Safety
Static - Drained	Rotational	2.61
	Block	4.19
	Non-circular	2.46
Static - Undrained	Rotational	4.44
	Block	5.36
	Non-circular	4.26
Pseudostatic	Rotational	1.33
	Block	1.31
	Non-circular	1.22
Post-seismic Residual	Rotational	1.88
	Block	2.09
	Non-circular	1.70

3.5.3.2 Settlement Analysis

Settlement of the final cover system was evaluated using Settle3D, version 4.016 by RocScience. The maximum expected settlement under the consolidation area and final cover loads was calculated as the sum of immediate and consolidation settlement. A fill height of approximately 20 feet above surrounding grade was assumed.

Consolidation parameters for the potentially fat clay (CH) under the cell were selected to evaluate the range in possible settlement. Both normally consolidated (NC) and overconsolidated (OC) conditions were considered for settlement evaluations. Details on the settlement evaluation methods and results are included in Appendix A.

The estimated total settlement of foundation soils at the cell crest ranges from about 6 inches (for OC clay) to over 3 feet (for NC clay). Over the proposed cover slope length of about 500 feet from crest to perimeter berm, and assuming little settlement at the perimeter berm, this could correspond to about 0.7 percent decrease in the cover slope for NC conditions, some of which would develop during construction (prior to cover construction). If the clay is NC, the potential slope decrease should be accounted for in the constructed cover slope. The OC settlement estimate can likely be accommodated by the cover without modifying the slope. Note that if soil liquefaction were to occur during the design earthquake (after cover construction), additional settlement could develop, in which case localized regrading may be required to re-establish the cover slopes.

The verification testing recommended in Section 3.5.3.2 should include collection of data to confirm the preconsolidation condition (NC or OC) of the in situ shallow clay soils.

3.5.3.3 Soil Loss Equation

The Universal Soil Loss Equation was used to estimate the amount of soil that could be expected to erode from the site during construction in a typical year. The restored completely vegetated conditions yield a soil loss of about 1 ton per acre per year, not including erosion protection included in the design. Generally acceptable soil loss is less than 2 tons per acre per year, indicating adequate design.

The highest levels of erosion occur during the construction of the consolidation area. Erosion control measures as shown in the drawings will be required to manage the high levels volumes of soil loss that are expected. Appendix A contains the Universal Soil Loss Equation calculation package.

3.5.3.4 Stormwater Calculations

Aside from the drainage for the constructed stream and wetlands, stormwater conveyance has been designed to promote runoff from the consolidation area cover system to the current drainage pathways.

Surface Water Routing

The design includes a stormwater management system designed to convey a 25-year, 24-hour storm to prevent flooding. Surface water runoff occurring within developed areas of the facility will be managed to control erosion, sedimentation, and stormwater discharges. Stormwater and erosion runoff will be as described in detail in the drawings and specifications. It will be controlled by using the following designed controls:

- Grass-lined perimeter ditches around the consolidation area, adequately sized to convey the 25-year, 24-hour storm event and designed to be stable consistent with National Resources Conservation Service (NRCS) Illinois Urban Manual Practice Standard, Grass Lined Channel Code 840.
- Silt fencing and erosion matting during construction.
- Vegetative buffers between construction and stormwater channels, if available.

Stormwater runoff was estimated using methods described in the U. S. Department of Agriculture, NRCS, Conservation Engineering, Division, Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds (June 1986). Calculations for the TR-55 methods were performed using WIN TR-55 with Soil Conservation Service methodology hydrologic modeling and use of WIN TR-55's dynamic routing capabilities for hydraulic calculations. The adequacy of the perimeter ditches around the consolidation area to convey the 25-year, 24-hour storm event was verified in U.S. Army Corps of Engineers HEC-RAS hydraulic engineering software, version 4.1.0. Stormwater calculations are provided in Appendix B.

In general, surface water on site flows from the top of the cover in all directions and down the 4 to 1 (horizontal to vertical) slopes to perimeter surface water ditches. Grass-lined ditches were designed with grass lining and seed mixes generally conforming to the NRCS Illinois Urban Manual Practice Standard Code 840. The geometry of the ditches is consistent across the site using a trapezoidal section with a bottom width of 15 feet and side slopes of 3H:1V. The depths of the ditches vary from 1.5 to 5.5 feet, depending on the location and the amount of runoff the ditch will receive.

Temporary stormwater management will include ditches and temporary check dams. Temporary sediment controls are described in Section 3.4.

3.6 Restoration

Restoration work includes seeding and placement of erosion control materials over the entirety of the disturbed area, including the consolidation area.

3.6.1 Seeding and Mulching

After placement of topsoil, the entire site will be seeded and mulched as described in the specifications.

3.6.2 Erosion Control

After seeding and mulching, the site will be covered with erosion-control matting as described in the specifications and as shown in the drawings.

3.6.3 Warranty Period

The restoration subcontractor will warranty the seeding and replace bare spots, if necessary, as identified within the warranty period and the project specifications. Watering after replacement will be provided by the property owner.

3.7 Post-construction Survey

A post-construction survey will be conducted to after reclamation is complete. The survey will serve to document the new site conditions to assist in monitoring the consolidation area.

3.8 Demobilization

Demobilization will include removal of the temporary facilities such as field trailer, utilities, material storage facilities, equipment decontamination facilities, and erosion and sediment control features. Until site restoration and demobilization are completed, construction oversight should be performed to will verify that erosion and sediment control features comply with the SWPPP.

The excavation and hauling equipment will not leave the site during excavation and transportation, so decontamination is not necessary until the equipment leaves the site. Wet decontamination shall be performed on all trucks that hauled contaminated soils, prior to final demobilization.

3.9 Post-construction Documentation

The owner's representative will prepare an RA completion report, including an ambient air monitoring report. The RA completion report will document the work completed by the owner's representative and its subcontractors using a report format in accordance with *Close Out Procedures for National Priorities List Sites, OSWER Directive 9320.2-22* (EPA 2011).

3.10 Operation and Maintenance

Continued inspection and maintenance are needed to ensure the longevity of the cover on the consolidation area. These activities will commence immediately following completion of the remedial action and will include inspecting the cover for damage (punctures, failures, and erosion), inspecting and maintaining erosion control, identifying vegetative stress and correcting as needed, mowing the vegetative cover, and ensuring institutional controls are in place. Monitoring reports will be prepared annually, and a site performance review will be performed every 5 years. The long-term maintenance plan provided in Appendix E specifies the requirements for the inspection, maintenance, and reporting.

SECTION 4

Compliance with Applicable or Relevant and Appropriate Requirements

This project is being performed in accordance with the CERCLA ROD for OAZ (EPA 2012). Under CERCLA, a requirement under environmental laws may be either applicable or relevant and appropriate to a removal action, but not both. *Applicable requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, RA, location, or other circumstances found at a CERCLA site. *Relevant and appropriate requirements* are cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable to a hazardous substance, pollutant, contaminant, RA, location, or other circumstances at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site, and are well-suited to the particular site.

Under CERCLA 121(e), onsite RAs do not need to comply with the administrative requirements of ARARs (environmental laws and regulations, such as permitting). Substantive requirements, however, must be met. Only state standards that are more stringent than federal requirements may be applicable or relevant and appropriate.

The statutes and regulations listed in Table 4-1 contain requirements deemed to be ARARs for the FA RA, and describe how the design will comply with those requirements. Table 4-1 is organized by two types of ARARs: action-specific and location-specific. Chemical-specific ARARs were described in the FS and the ROD, and were used to develop the RAOs described in Section 1.3. Therefore, they are not described in this BODR. Of the ARARs described in the ROD, only those determined to relate to the selected remedy for the FA RA are included in Table 4-1. Federal ARARs that are implemented by the state are not shown in Table 4-1; rather, the state regulation that was also in the ROD is described. Table 4-2 identifies key regulations from the ROD that related to offsite management of hazardous waste; such regulations will be complied with in full.

4.1 Minimizing Public and Environmental Impacts

Environmental and public health and welfare impacts will be minimized through the following methods:

- Site access control
- Development of and adherence to SWPPP
- Transportation and disposal of contaminated and backfill materials
- Compliance with permits/codes

4.1.1 Site Access Control

Access control to the site during construction is necessary to prevent exposure of non-RA personnel to contaminated soil. Access will be controlled by maintaining fencing around the FA, and updating where needed. Typical working hours for construction activities will be 7:00 a.m. to 6:00 p.m., Monday through Friday.

4.1.2 Stormwater Management

Subcontractors will be required to implement procedures during construction activities to prevent or reduce pollutants in stormwater discharges, consistent with NPDES Permit No. ILR10. As a matter of coordination, St. Clair County requirements will also be considered. Stormwater pollution prevention features and erosion control features will be described in the SWPPP designed to reduce stormwater pollution potential at the site. The following erosion and sediment control measures will be identified in the plan:

- Silt fence
- Temporary covering of stockpiles
- Appropriate best management practices at construction site entrance and exit
- Inspections and maintenance procedures

Spill and release accident scenarios could occur and involve rinsates from decontamination activities or contaminated soil. Also, the potential exists for spills of vehicle fuel and hydraulic oils. The SWPPP will address the following activities:

- Preplanning for spill control
- Spill and fire control materials and equipment
- Spill control measures
- Drum, container, and tank handling and moving procedures

The plans will also provide instructions to respond to and mitigate releases on the project site.

4.1.3 Transportation and Disposal

The transportation and disposal plan will describe transporting and disposing of contaminated debris and aqueous waste, and importing materials from approved borrow sources. The transport vehicles will be tarped or otherwise covered to enclose all loads of contaminated and non-contaminated material during all phases of transportation. The transportation and disposal plan will address the following:

- Identification of all waste streams
- Decontamination procedures
- Waste characterization and profiling
- Waste and container management, storage, labeling, and marking
- Waste transportation practices
- Manifests/haul tickets and other shipping documentation, if required
- Waste disposal, if required
- Spill response and reporting
- Dust abatement
- Traffic control, including any necessary road closure permits or protective measures
- Records and reporting

Table 4-1. Applicable or Relevant and Appropriate Location-Specific and Action-Specific Requirements for the Selected Remedy
Old American Zinc Superfund Site Facility Area

Requirement	Requirement Synopsis	Status
Location-specific ARARs		
Migratory Bird Treaty Act of 1972 (16 United States Code 703-712)	Establishes federal responsibility for the protection of the international migratory bird resources. Taking, killing, or possessing migratory birds without authorization is unlawful.	Applicable. Illinois is located within the Mississippi flyway. The design includes procedures to minimize disturbance and avoid destroying active nests (that is, tree clearing will occur outside of the nesting season). If migratory birds need to be disturbed, consultation with the U.S. Fish and Wildlife Service will occur.
Executive Order on Floodplain Management (Executive Order No. 11988, 40 *Code of Federal Regulations* Part 6.302(b) and Appendix A	Requires agencies to evaluate the potential effects of actions to reduce the risk of flood loss; to minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains.	To Be Considered. A portion of the Site is located within the 100-year floodplain. The consolidation area and has been located outside of the 100-year floodplain.
Action-specific ARARs		
State Certifications and NPDES (40 Code of Federal Regulations Part 122.26(a)(14)(x))	Requires the development and implementation of a water pollution prevention plan or a stormwater best management plan. Also outlines monitoring and inspection requirements for a variety of activities. Illinois Environmental Protection Agency implements the NPDES program and the associated stormwater management requirements.	Applicable. The substantive requirements of the Illinois NPDES General permit for Stormwater Discharge from Construction Site Activities will be followed.
Illinois Water Quality Standards (35 IAC, Subtitle C, Chapter 1, Part 302)	Regulations that establish numerical standards and procedures for deriving criteria for toxic substances without numerical standards to restore, maintain, and enhance purity of the water of the state.	Applicable. The substantive requirements of the Illinois NPDES General Permit for Stormwater Discharge from Construction Site Activities may be either applicable or relevant and appropriate, depending upon the total disturbed area.
Illinois Standards for New Solid Waste Landfills (IAC Title 35, Part 807.305(c) Cover)	Cover requirements include “Final Cover – a compacted layer of not less than 2 feet of suitable material.”	Relevant and Appropriate. The contaminated material containing hazardous substances will be relocated into a consolidation area, which will have a cover consisting of a 24-inch compacted low-permeability clay barrier, overlain by a 12-inch vegetative soil cover.
Illinois Solid Waste and Special Waste Handling, Location Standards for New Landfills (IAC Title 35, Part 811.102)	New landfills cannot be located to restrict the flow of a 100-year flood, result in washout, or reduce the temporary water storage capacity of the 100-year floodplain unless specified measures are taken. Facility shall not violate Section 404 of the Clean Water Act, and other requirements	Relevant and Appropriate. The RD has located the consolidation area outside of the 100-year floodplain

Table 4-1. Applicable or Relevant and Appropriate Location-Specific and Action-Specific Requirements for the Selected Remedy

Old American Zinc Superfund Site Facility Area

Requirement	Requirement Synopsis	Status
IAC Title 35, Part 808 Illinois Special Waste Regulations	Generators are required to classify the waste, manifest the waste, use permitted transporters, and dispose of the waste at a permitted facility	Applicable. Liquids generated by the remedial action would be considered pollution control waste.
Illinois Hazardous Waste Management System (IAC Title 35, Section 722.130-724.134 Pre-Transport Requirements)	Generator standards for packaging, labeling, marking, and accumulation prior to offsite transport of hazardous waste.	Applicable to tarry waste if encountered and deemed characteristically hazardous. Such materials are to be disposed of offsite at a permitted RCRA Subtitle C facility.
Fugitive Particulate Matter (IAC Title 35, Part 212, Subpart K)	Establishes requirements for dust control in Sections 212.301, 212.315, and 212.316.	Applicable. The RA may generate fugitive dust; the design addresses methods to minimize and control dust to meet the regulatory standard.
Illinois Clean Fill Regulations (IAC Title 35, Part 1100)	State regulations governing clean fill operations	Applicable if imported soil fill is component of remedy to fill excavated areas.
Subpart S - Special Provisions for Cleanup, Staging Piles (IAC Title 35, Subchapter c, Part 724.654)	Standards applicable for staging piles.	Applicable. The RA may generate fugitive dust; the design addresses methods to minimize and control dust to meet the regulatory standard.
Illinois Uniform Environmental Covenants Act (765 Illinois Compiled Statutes 122)	The purpose of an environmental covenant is to ensure that land use restrictions and engineering controls designed to control the potential environmental risk of residual contamination will be recorded in the land records and enforced over time, perpetually if necessary, while allowing that real estate to be conveyed from one person to another subject to those controls.	Applicable. The design addresses securing an environmental covenant at locations where cleanup does not achieve unrestricted use standards, to ensure that land use restrictions and engineering controls are recorded in the land records and enforced over time.
Noise (IAC Title 35, Subtitle H: Part 900.102-106)	Regulations contain specific requirements that pertain to nuisance noise levels, sound emission standards, and limitations.	Applicable. The design will specify the noise levels set forth in the regulations that will not be exceeded during the RA.
Guidance for NPDES Construction Site Stormwater Discharges in the State of Illinois	Guidance related to implementation of the Federal Clean Water Act General Construction Permit program in Illinois.	Applicable. Guidance for controlling stormwater discharges associated with construction will be considered in developing the SWPPP.

Table 4-2. Other Key Regulatory Requirements
Old American Zinc Superfund Site Facility Area

Requirement	Requirement Synopsis	Status
Illinois Hazardous Waste Manifest System: General (IAC Title 35 Part 720 et. seq)	Provides requirements for the transport and disposal of hazardous waste.	The RD will require that characteristically hazardous materials, if encountered, be transported and disposed of offsite in full compliance with these regulations.
Department of Transportation (DOT) Hazardous Materials Transportation Regulations (49 *Code of Federal Regulations* Parts 107, 171-177)	Regulates transportation of hazardous materials, including hauler registration, identification codes, placarding, and manifesting.	The RD will require that characteristically hazardous materials, if encountered, be transported offsite in full compliance with these regulations.
Occupational Safety and Health Act (OSHA) (29 *Code of Federal Regulations* 1910.120)	Specifies minimum requirements to maintain worker health and safety for hazardous waste sites. Includes specific training, monitoring, respiratory protection and personnel protective requirements based on site-specific conditions.	The RD will specify compliance with OSHA.

SECTION 5

Construction Schedule

The RA construction is assumed to start in 2019 and is assumed to occur over the course of two construction seasons. The contractor may expedite the schedule by using multiple crews or by extending the construction season. Depending on the anticipated weather over the course of the winter months, the contractor may propose to work through the winter. This would result in a reduction in the contract price as there will only be one mobilization and demobilization cost. The schedule is shown on Figure 5-1.

SECTION 6

Engineer's Estimate of Construction Cost

The engineer's estimate of construction cost for the RA, as described in this report, is estimated at $48,999,426 (Class 4 with an accuracy of plus 50 percent to minus 30 percent). Appendix F contains the cost estimate. The cost estimates have been prepared for guidance in project evaluation and implementation from the information available at the time that the cost estimate was prepared. The final costs of the project will depend on actual labor and material costs, competitive market conditions, actual site conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the cost estimates presented in the final design. Because of these factors, project feasibility and funding needs must be carefully reviewed before specific financial decisions are made or project budgets are established to help ensure project evaluation and adequate funding.

SECTION 7

Drawings

Drawings are provided in Appendix G. Table 7-1 lists the drawings.

Table 7-1. List of Drawings
Old American Zinc Superfund Site Surrounding Properties

Drawing Number	Drawing Name
G-001	Title, Location Maps and Index to Drawings
G-002	Legend and General Notes
C-001	Facility Area Existing Conditions
C-002	Erosion and Sediment Control Plan
C-003	Sequence of Construction
C-004	Consolidation Area Prep
C-005	Consolidation Area Excavation
C-006	Consolidation Area Construction
C-007	Consolidation Area Construction Clay Cover
C-008	Site Restoration Clay Cover
C-009	Proposed Restoration and Top of Consolidation Area Grades
C-010	Consolidation Area Sections
C-011	Details

SECTION 8

Specifications

The following specifications are included in Appendix C:

DIVISION 1—GENERAL REQUIREMENTS	
01 11 00	Summary of Work
01 29 00	Payment Procedures
01 31 13	Project Coordination
01 31 19	Project Meetings
01 32 00	Construction Progress Documentation
01 33 00	Submittal Procedures
01 45 16.13	Subcontractor Quality Control
01 50 00	Temporary Facilities and Controls
01 57 13	Temporary Erosion and Sediment Control
01 77 00	Closeout Procedures
DIVISION 31—EARTHWORK	
31 10 00.00	Site Clearing
31 23 13	Subgrade Preparation
31 23 16	Excavation
31 23 23	Fill and Backfill
DIVISION 32—EXTERIOR IMPROVEMENTS	
32 91 13	Soil Preparation
32 92 00	Turf and Grasses

SECTION 9

Constructability and Biddability Review

Staff from CH2M's affiliate, CH2M HILL Constructors, Inc., reviewed the BODR and specifications with an emphasis on constructability. In addition, this BODR and specifications were reviewed by the project review team, and comments were incorporated, as appropriate. A biddability review will be performed for the final design and solicitation package (under separate cover).

SECTION 10

References

ENTACT. 2009. *Final Remedial Investigation Report, Old American Zinc Plant Site, Fairmont City, Illinois.* March.

ENTACT. 2012. *Final Feasibility Study Document for the Old American Zinc Plant Site, Fairmont City, Illinois.* February.

CH2M HILL, Inc. (CH2M). 2017. *Old American Zinc Plant Superfund Site, Fairmont City, St. Clair County, Illinois, Remedial Design*. February.

Illinois Environmental Protection Agency (IEPA). 2014. *General National Pollutant Discharge Elimination System (NPDES) Permit for Storm Water Discharges from Construction Site Activities, General NPDES Permit No. ILR10 Modification.* April.

Illinois Joint Committee on Administrative Rule. Illinois Administrative Code Title 35: Environmental Protection.

U. S. Department of Agriculture, NRCS, Conservation Engineering, Division. 1986. Technical Release 55 (TR-55), Urban Hydrology for Small Watersheds. June.

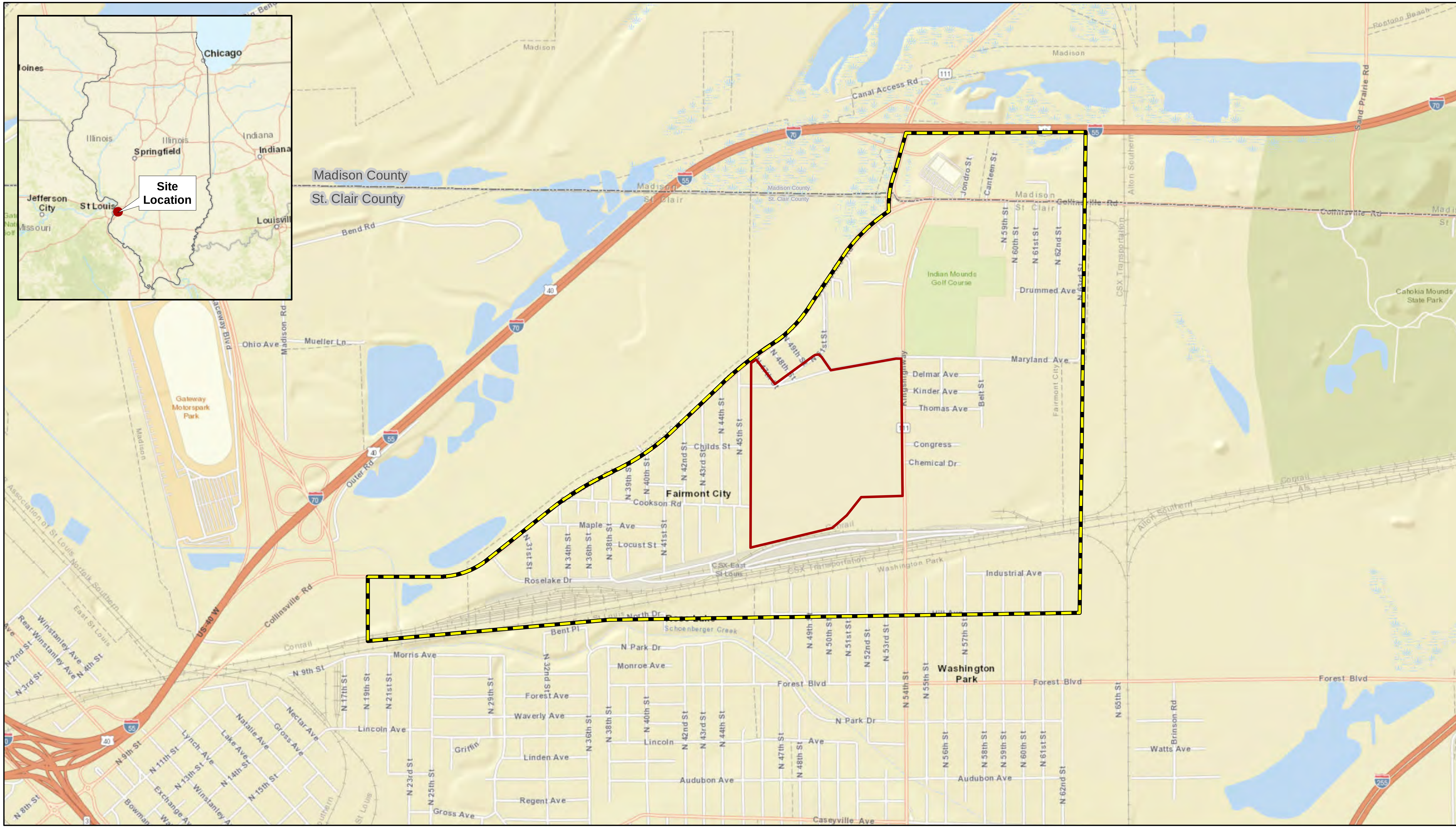
U.S. Environmental Protection Agency (EPA). 2012. *Record of Decision, Old American Zinc Plant Superfund Site*. September.

U.S. Environmental Protection Agency (EPA). 1995. *Remedial Design/Remedial Action Handbook.* Office of Emergency and Remedial Response. Publication 540/R-95/059. June.

U.S. Environmental Protection Agency (EPA). 2011. *Close Out Procedures for National Priorities List Sites, OSWER Directive 9320.2-22.*

U.S. Geological Survey (USGS). 2018. Earthquake Hazards Program website. <https://earthquake.usgs.gov/designmaps/us/application.php>.

Figures



Legend

County Boundary

Facility Area Boundary

Surrounding Properties Boundary (Approximate)

0 800 1,600

Feet

N

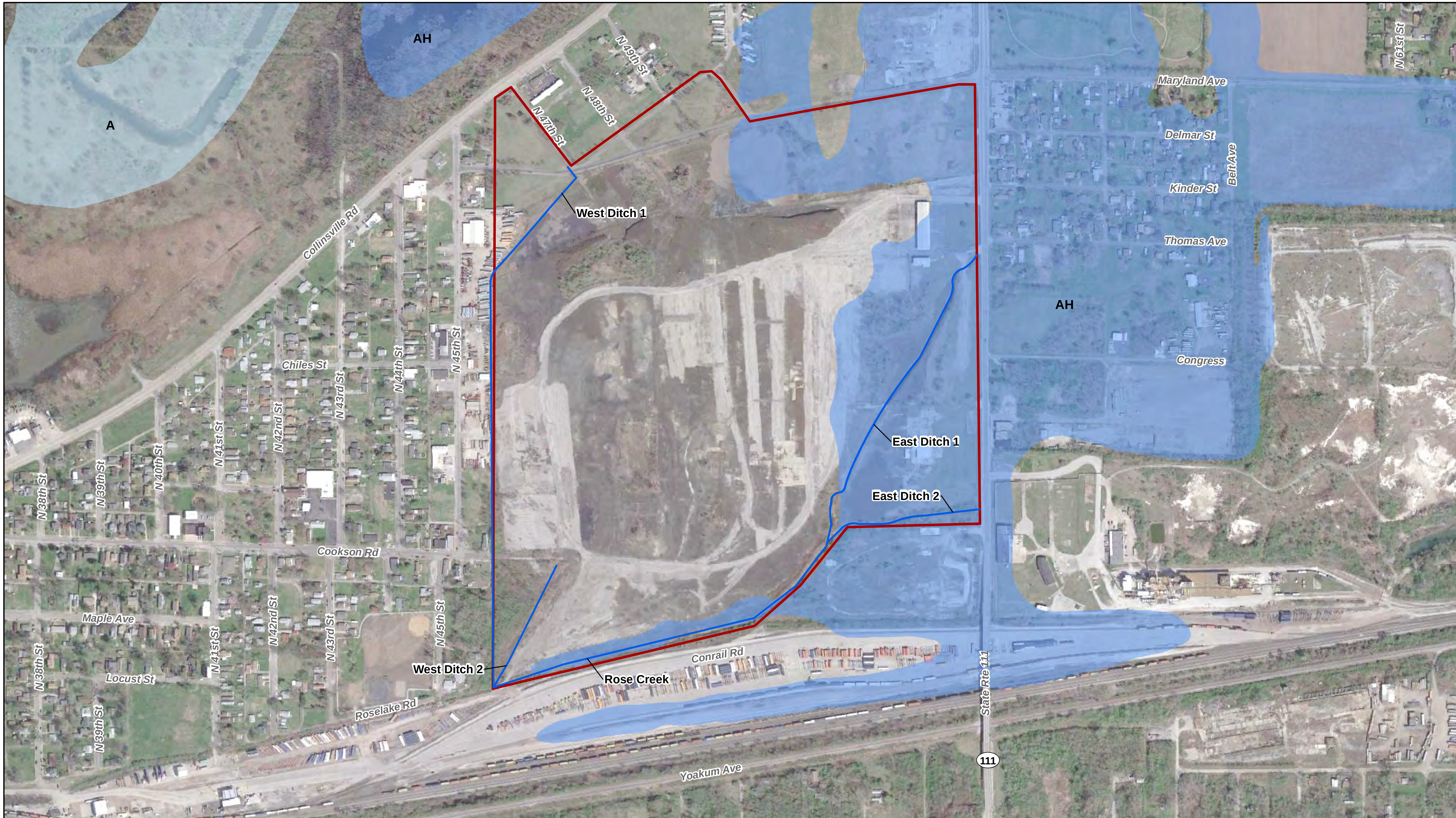
Notes:

1. Basemap provided by ArcGIS Online World Street Map.

Figure 1-1
Site Location Map
Old American Zinc Plant Superfund Site
Fairmont City, Illinois

ch2m:

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE1-1_SITE_LOCATION_MAP.MXD AESPEJO 4/25/2018 3:40:10 PM



Legend

- Drainage Ditch
- Facility Area Boundary

0 250 500
Feet

N

FEMA 100-Year Flood Zones

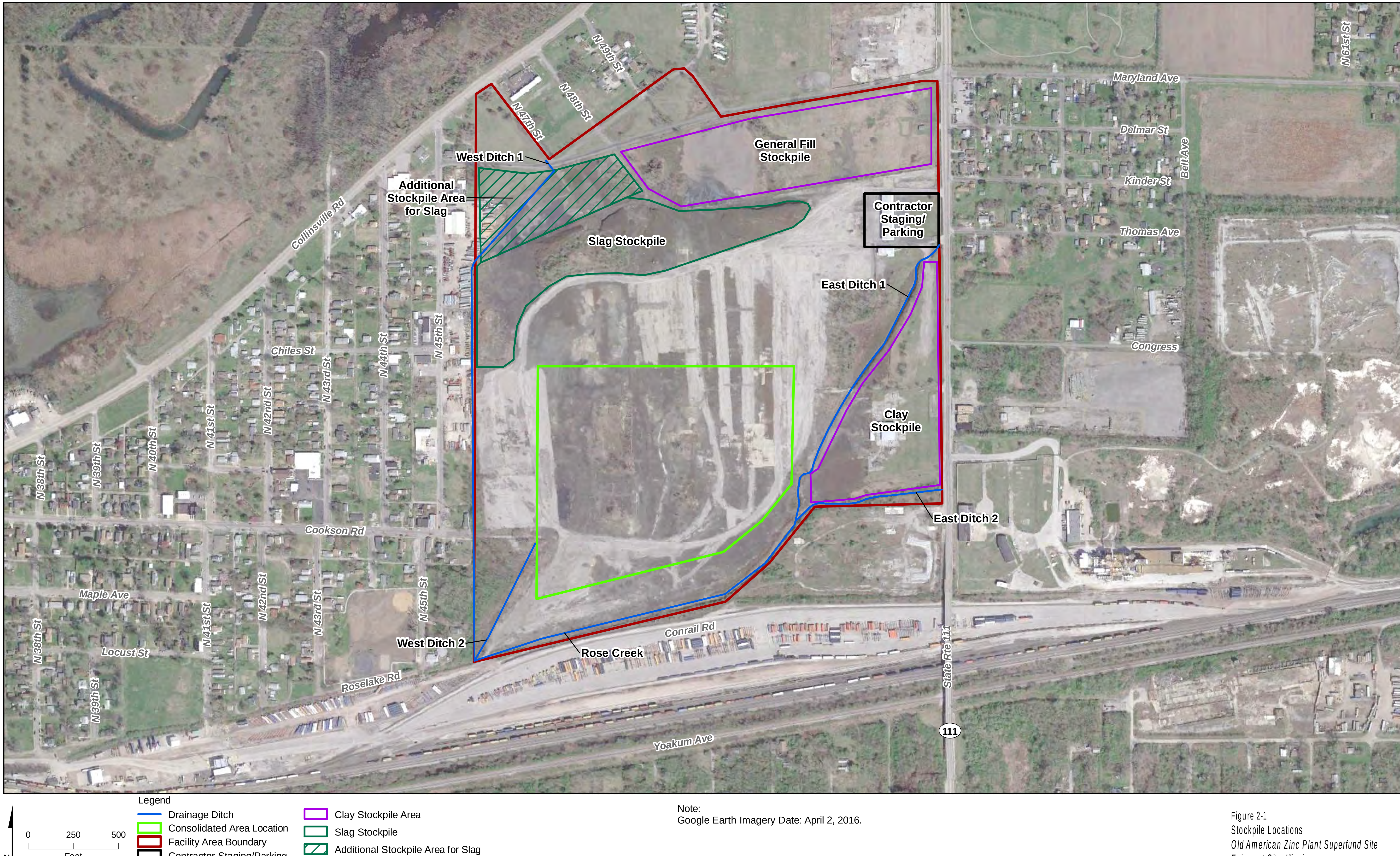
- A - No Base Flood Elevations Determined
- AH - Flood Depths of 1 to 3 Feet (Usually Areas of Ponding); Base Flood Elevations Determined

Note:
Google Earth Imagery Date: April 2, 2016.

Figure 1-2
Floodplain Map
Old American Zinc Plant Superfund Site
Fairmont City, Illinois

ch2m

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE1-2_FLOODPLAIN_MAP.MXD AESPEJO 5/3/2018 3:30:03 PM



Note:
Google Earth Imagery Date: April 2, 2016.

Figure 2-1
Stockpile Locations
Old American Zinc Plant Superfund Site
Fairmont City, Illinois

ch2m.

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE2-1_STOCKPILE_LOCATIONS.MXD AESPEJO 5/11/2018 9:36:19 AM

Legend

Drainage Ditch

Consolidated Area Location

Facility Area Boundary

FEMA 100-Year Flood Zones

A - No Base Flood Elevations Determined

AH - Flood Depths of 1 to 3 Feet (Usually Areas of Ponding); Base Flood Elevations Determined

N

0 250 500
Feet

Note:
Google Earth Imagery Date: April 2, 2016.

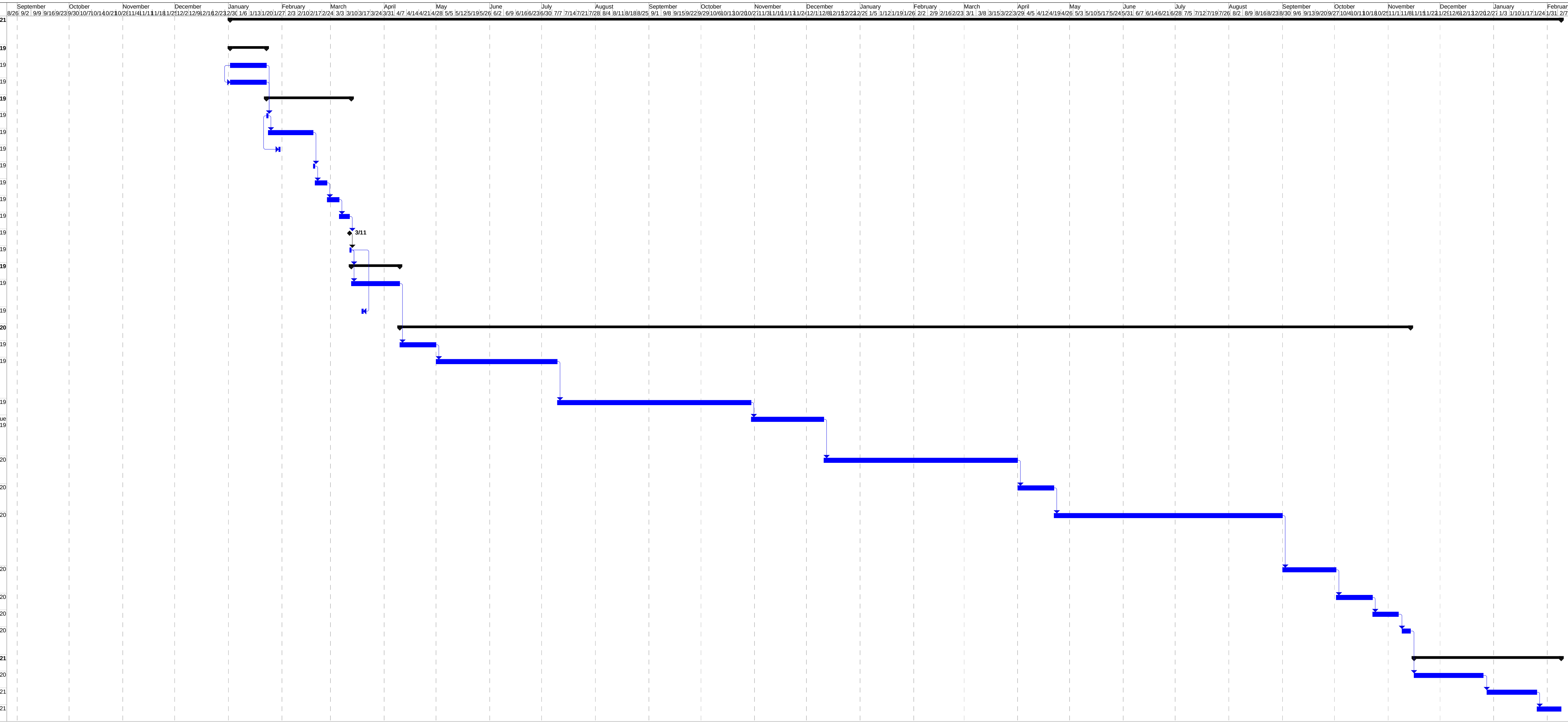
Figure 3-1
Consolidation Area Location
Old American Zinc Plant Superfund Site
Fairmont City, Illinois

ch2m

R:\ENBG\00_PROJ\E\EPA\OLDAMERICANZINCSITE\MAPS\REPORT\2018\MISC\FIGURE3-1_CONSOLIDATION_AREA_LOCATION.MXD AESPEJO 5/3/2018 3:32:44 PM

Figure 5-1 Old American Zinc Remedial Action Schedule

ID		Task Name	Duration	Start	Finish
1		**Remedial Action - Old American Zinc Plant Superfund Site, Facility Area**	**549 days**	**Wed 1/2/19**	**Mon 2/8/21**
2		**Pre-Bid Activities**	**15 days**	**Wed 1/2/19**	**Tue 1/22/19**
3		Prepare Subcontractor SOW	15 days	Wed 1/2/19	Tue 1/22/19
4		Prepare Subcontract Bid Documents	15 days	Wed 1/2/19	Tue 1/22/19
5		**Bidding Activities**	**35 days**	**Wed 1/23/19**	**Tue 3/12/19**
6		Issue Bid Documents	1 day	Wed 1/23/19	Wed 1/23/19
7		Bid Process	18 days	Thu 1/24/19	Mon 2/18/19
8		Pre-Bid Meeting	1 day	Wed 1/30/19	Wed 1/30/19
9		Bids Due	1 day	Tue 2/19/19	Tue 2/19/19
10		Evaluate Bids/Fact Finding	5 days	Wed 2/20/19	Tue 2/26/19
11		Prepare Consent Package for EPA	5 days	Wed 2/27/19	Tue 3/5/19
12		EPA Review Consent Package	4 days	Wed 3/6/19	Mon 3/11/19
13		Obtain Consent from EPA	0 days	Mon 3/11/19	Mon 3/11/19
14		Issue Notice of Award	1 day	Tue 3/12/19	Tue 3/12/19
15		**Submittals**	**20 days**	**Wed 3/13/19**	**Tue 4/9/19**
16		Subcontractor Develops Premobilization Submittals	20 days	Wed 3/13/19	Tue 4/9/19
17		Borrow Source Sampling	1 day	Tue 3/19/19	Tue 3/19/19
18		**Construction**	**418 days**	**Wed 4/10/19**	**Fri 11/13/20**
19		Mobilization and Site Preparations	15 days	Wed 4/10/19	Tue 4/30/19
20		Removal of slag from consolidation area and stockpile footprints	50 days	Wed 5/1/19	Tue 7/9/19
21		Consolidation Area excavation	80 days	Wed 7/10/19	Tue 10/29/19
22		Place Slag from Stockpile in Consolidation Area and Compaction	30 days	Wed 10/30/19	Tue 12/10/19
23		Contractor Demobilize for the Season	80 days	Wed 12/11/19	Tue 3/31/20
24		Contractor Mobilize and Perform Site Maintenance	15 days	Wed 4/1/20	Tue 4/21/20
25		Complete slag placement in Consolidation Area (resume activity from before seasonal break).	94 days	Wed 4/22/20	Mon 8/31/20
26		Place Clay Cover on Consolidation Area	23 days	Tue 9/1/20	Thu 10/1/20
27		Place Topsoil on Site	15 days	Fri 10/2/20	Thu 10/22/20
28		Site Restoration	11 days	Fri 10/23/20	Fri 11/6/20
29		Final Punch List and Demobilization	5 days	Mon 11/9/20	Fri 11/13/20
30		**Construction Completion Report**	**61 days**	**Mon 11/16/20**	**Mon 2/8/21**
31		Prepare Draft Construction Completion Report	30 days	Mon 11/16/20	Fri 12/25/20
32		EPA/IEPA Review	21 days	Mon 12/28/20	Mon 1/25/21
33		Submit Final Construction Completion Report	10 days	Tue 1/26/21	Mon 2/8/21



Old American Zinc Prefinal RA Schedule
Note: Dates are estimated; actual RA start date is TBD.
Date: Fri 5/18/18

Task | Split | Milestone | Summary | Project Summary | External Tasks | External Milestone | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Progress | Deadline

Appendix A
Slope Stability Calculations

Calculation Summary

Calculation No.: Geotech_Calc_Packet_ 687729OAZ_001 **Revision No.:** 0

Project: 687729OAZ

Engineering Discipline: Geotechnical **Date:** 04/23/2018

Calculation Title & Description:

Title: Global Stability and Settlement of the Eagle Zinc on Site Management Cell

Description: This calculation documents the global stability and settlement evaluations for the proposed residuals repository at the Old American Zinc Plant Site in Fairmont City, Illinois.

Revision History:

Revision No.	Description	Date	Affected Pages
0	Initial Submittal	04/23/2018	All

Document Review & Approval:

Originator: Pablo Toloza / Geotechnical Engineer

NAME/POSITION

SIGNATURE DATE

Checked: Matthew Gavin, P.E. / Geotechnical Engineer

NAME/POSITION

SIGNATURE DATE

1. Subject / Objective / Purpose

This calculation package documents the global stability and settlement evaluations for the proposed residuals repository at the Old American Zinc Plant Site, located in Fairmont City, Illinois.

The Old American Zinc Plant Site is an inactive industrial facility located in Fairmont City, St. Clair County, Illinois. The site includes the 132-acre former zinc smelter facility area (Facility Area) where historical smelting operations and more recent former intermodal trucking operations were conducted, as well as offsite areas (residential, commercial, and vacant properties around the Facility Area; alleyways owned by the Village of Fairmont City that have been filled or resurfaced with slag; and drainageways that receive drainage from the Facility Area) and shallow groundwater within and immediately adjacent to the Facility Area.

A new repository will be built to accommodate over 900 kcy of slag and residuals excavated from the vicinity. Native clay underneath the slag will be excavated to form the bottom of the cell at approximate elevation 410 ft (up to 10 feet below surrounding grade). The slag material will be placed and compacted in lifts. A minimum of 24 inches of compacted soil cover will be placed on top of the slag and residuals, and 12 inches of top soil cover will overlay the compacted clay. The planned final slopes are 4H:1V on the perimeter berms and 3 percent on top of the cover. The maximum cell height will be approximately 30 feet, or about 20 feet above surrounding grade.

2. Methodology

Slope stability analyses were performed using SLIDE v. 7.0, a two-dimensional model, to evaluate the factors of safety (FS) against global stability failure. SLIDE is based on the principle of limit equilibrium; that is, it calculates the shear strengths required to maintain equilibrium and then computes a factor of safety (FS) by dividing the available shear strength by the shear strength required to maintain stability. SLIDE generates a large number of potential failure surfaces and calculates the FS for each surface. Rotational (circular) and translational (block and non-circular) surfaces were evaluated using the Spencer method. Drained and undrained static, seismic (pseudostatic), and post-seismic conditions were evaluated.

The cross-section for analysis was selected along the southeast edge of the proposed cell, which represents the maximum cell height and conservatively assumes the perimeter ditch is at the toe of slope.

Limited geotechnical strength data are available for the proposed cell footprint, although general soil types and stratigraphy have been documented by previous soundings and monitoring wells. Therefore, reasonably conservative drained and undrained soil properties were assumed, based on typical values for similar materials as discussed in Section 2.2 and 2.3. Recommendations to verify these strength parameters prior to construction are discussed in Section 4.

Seismic (pseudostatic) analyses were performed using a conservative pseudostatic coefficient (k_h) of 50 percent of the peak ground acceleration (PGA) for the 2,475-year return period earthquake (USGS, 2018). Strength reduction factors were used for the pseudostatic and post-seismic analyses, as discussed in Section 2.3.

Settlement of the final cover systems was evaluated using Settle3D, version 4.016. The maximum expected settlement under the consolidation cell and final cover loads was calculated as the sum of immediate and consolidation settlement.

2.1 Analysis Criteria

The design criteria for post-closure slope stability factors of safety (FS) for the most critical slopes at the cell unit are shown in Table 1. 35 IAC 811.304 requires that for solid waste facilities, the minimum factor of safety (FS) against slope failure is 1.5 for static conditions. Federal Subtitle D landfill regulations do not specify a minimum seismic FS, so long as slope deformations are tolerable; i.e., 6 to 12 inches are commonly considered acceptable (USEPA, 1995). Using a conservative pseudostatic coefficient of 0.5 (PGA) for the 2,475-year return period earthquake, a pseudostatic FS of 1.0 or greater is expected to correspond to deformations in this range or less. Post-seismic FS is also checked to verify stability even if foundation soil liquefaction were to occur; Illinois-specific post-seismic FS criteria are not published, but 40 CFR 257 requires a minimum post-seismic FS of 1.2.

Table 1: Design Criteria

Case	Minimum FS
Static – drained	1.5
Static – undrained	1.5
Seismic (pseudostatic)	1.0
Post-seismic (residual strength)	1.2

2.2 Subsurface Conditions

In March of 2009, ENTACT, LLC prepared an Investigation report (ENTACT, 2009), documenting an environmental field investigation performed between 2006 and 2008. 120 geoprobe borings between 4 to 16 feet deep, 7 hand auger borings between 3.5 to 6 feet, 10 wells between 16 to 24 feet deep, and 3 hollow stem auger borings up to 76 feet deep were used to prepare the stratigraphy within the facility.

The subsurface shown in section A-A of the report consist of the following (from top to bottom):

- 4 to 8 feet of slag,
- Approximately 15 feet of Fat Clay, Silty Clay and Clayey silt, from elevation 420 to 405,
- 10 to 20 feet of silt, sand, and mud, from elevations 418 to 387,
- 30 to 35 feet of Fine sand and silt, from elevations 345 to 388, and
- Fine to coarse sand below elevation 360.

Geotechnical strength and consistency data in the report is limited to two borings with SPT blowcounts (SPT N-values) reported for silt and sand below 20 feet bgs. These data indicate the deep silt and sand is medium dense (with SPT N greater than 20), but other soil boring log descriptions indicate the shallower silt and sand could be in a looser condition. Index tests performed on clay samples from test pits indicate that fat clay (USCS classification of CH) are common at the site.

2.3 Geotechnical Engineering Properties

The selected geotechnical parameters for slope stability evaluations are summarized in Table 2. Due to the very limited amount of geotechnical strength and consistency data, conservative strength parameters were selected for the stability and settlement analyses. As discussed in more detail below, testing is recommended prior to cell construction to confirm these parameters.

For seismic (pseudostatic) analyses, an undrained shear strength of 80 percent of the assumed static (peak) shear strength was assigned.

For post-seismic analyses, an undrained shear strength of 65 percent of the static (peak) shear strength was assigned for cohesive soils. For the saturated, potentially loose shallow silts and sands, a post-seismic shear strength ratio (Su/σ') of 0.1 was conservatively assumed to account for the potential "worst-case" of liquefaction of this layer. For unsaturated or denser granular materials (compacted residuals and medium dense foundation sands), 80 percent of the static (peak) strength was assigned.

Soil parameters used in the global stability analyses are listed in Table 2.

Consolidation parameters for the potentially fat clay (CH) under the cell were selected to evaluate the range in possible settlement. Both normally consolidated (NC) and overconsolidated (OC) conditions were considered for settlement evaluations.

Table 2: Geotechnical Engineering Strength Parameters by Stratum

Stratum	Description	Moist Unit Weight	Assumed Shear Strength Parameters								
			Static			Pseudostatic			Post-Seismic Residual		
		γ_m	c'	ϕ'	S_u	c'	ϕ'	S_u	c'	ϕ'	S_u
		(pcf)	(psf)	(deg)	(psf)	(psf)	(deg)	(psf)	(psf)	(deg)	(psf)
Ia	Fill - Top Soil - Stiff	130	0	25	1500	--	--	0.8x Su	--	--	0.65 x Su
Ib	Fill – Slag and Residuals	120	0	23	(drained)	0	18.8	(drained)	0	18.8	(drained)
Ic	Fill - Clay - Stiff	128	0	29	1000	--	--	0.8x Su	--	--	0.65 x Su
IIa	Native - Clay - Stiff	128	50	29	1000	--	--	0.8x Su	--	--	0.65 x Su
IIb	Native - Silt - V. Loose	115	0	24	(drained)	0	19.6	(drained)	--	--	$Su/\sigma_v'=0.1$
IIc	Native - Sand - M. Dense	125	0	29	(drained)	0	23.9	(drained)	0	23.9	(drained)

2.4 Water Table

Based on monitoring well data, it is anticipated that the water table is about elevation 405. For analysis purposes, water table was considered 415, which is at the bottom of the perimeter ditch.

3. Results, Interpretation of Results, and Recommendations

The resulting global stability FS are summarized in Table 3. Full results, including the SLIDE profiles showing critical surfaces, are included in Attachment B. As shown in Table 3, all analyses satisfy the minimum FS criteria based on the soil strength parameters assumed in Table 2.

The estimated total settlement of foundation soils at the cell crest ranges from about 6 inches (for OC clay) to over 3 feet (for NC clay). Over the proposed cover slope length of about 500 feet from crest to perimeter berm, and assuming little settlement at the perimeter berm, this corresponds to about 0.7 percent decrease in the cover slope for NC conditions, some of which would develop during construction (prior to cover construction). If the clay is NC (to be confirmed prior to construction), this potential slope decrease should be accounted for in the constructed cover slope. The OC settlement estimate can likely be accommodated by the cover without modifying the slope. NOTE: If soil liquefaction were to occur during the design earthquake (after cover construction), additional settlement could develop, in which case localized regrading may be required to re-establish the cover slopes.

Table 3: Factor of safety – Global Stability Analyses

Case	Shape of Slip surface	FS
Static - Drained	Rotational	2.61
	Block	4.19
	Non-circular	2.46
Static - Undrained	Rotational	4.44
	Block	5.36
	Non-circular	4.26
Pseudostatic	Rotational	1.33
	Block	1.31
	Non-circular	1.22
Post-seismic Residual	Rotational	1.88
	Block	2.09
	Non-circular	1.70

While the soil parameters in Table 2 are considered reasonably conservative for typical soils, limited geotechnical strength or consistency data is available within the cell footprint. Therefore, we recommend that verification testing be performed within the proposed cell footprint to confirm that the soil parameters in Table 2 are representative, and to evaluate the consolidation condition of the foundation clays (NC or OC). This could be done by a grid of CPT soundings around the perimeter of the proposed cell berm, possibly combined with a few samples collected for geotechnical analysis (index, strength, and consolidation tests).

4. References

ENTACT, LLC (2009). Final Remedial Investigation Report. Old American Zinc Plant Site. Fairmont City, Illinois. Revision 2.

Bray, Jonathan D. and Thaleia Travasarou. 2009. Pseudostatic Coefficient for Use in Simplified Seismic Slope Stability Evaluation. J. Geotechnical and Geoenvironmental Eng., ASCE. 1336-1340. September.

Rocscience Inc. (2015) "SLIDE version 7, 2D Limit Equilibrium Slope Stability for Soil & Rock Slopes".

Stark, T.D. and I.A. Contreras, “Fourth Avenue Landslide During 1964 Alaskan Earthquake,” Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 124, No. 2, February, 1998, pp. 99-109.

USEPA, 1995. RCRA Subtitle D (258) Seismic Design Guidance for Solid Waste Landfill Facilities.

USGS, 2018. Earthquake Hazards Program website. https://earthquake.usgs.gov/designmaps/us/application.php .

5. List of Attachments

A. Plan view and Cross Sections

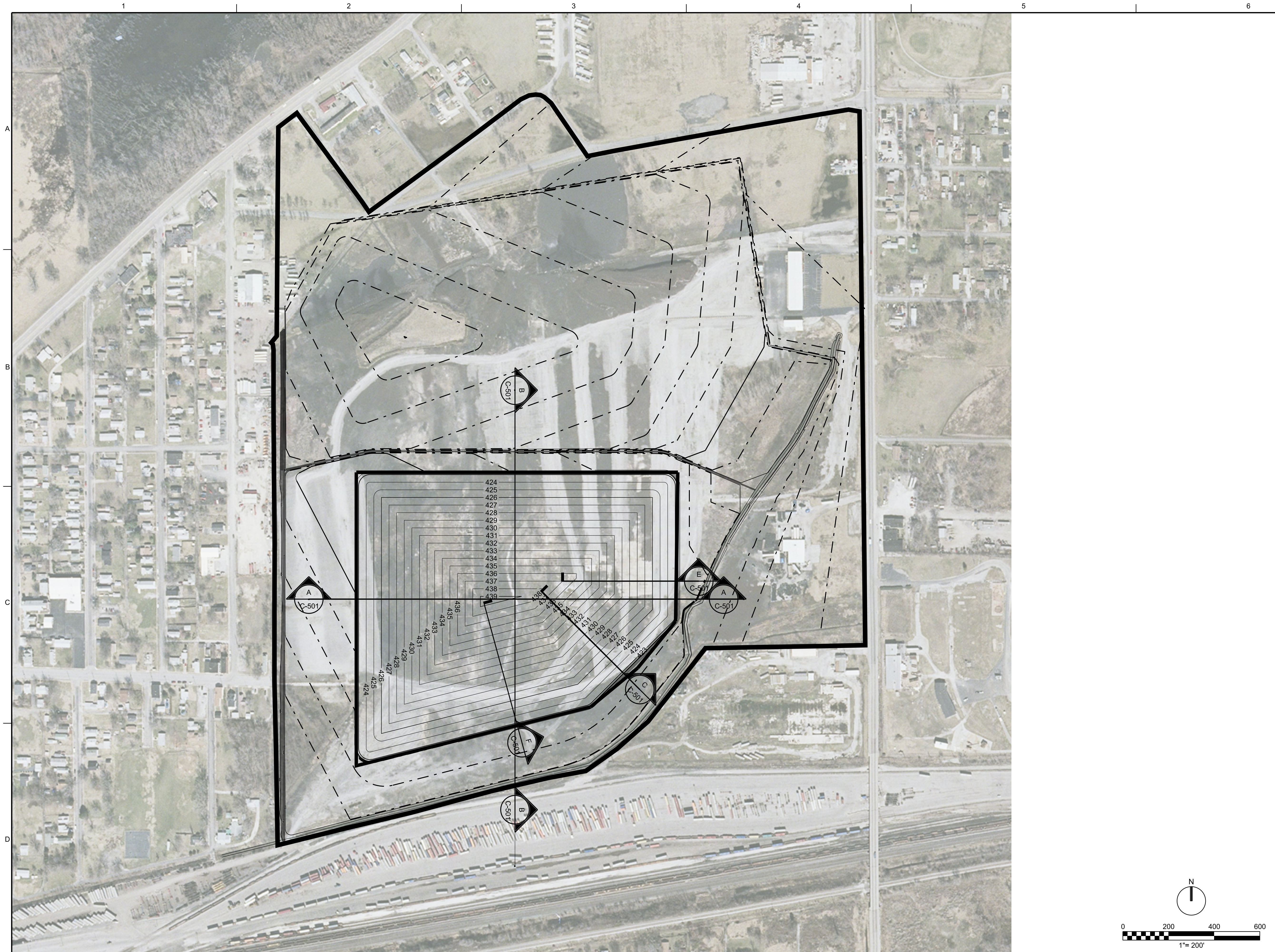
B. Global Stability Analyses

C. Settlement Analyses

D. Seismicity Data

Attachment A

Plan view and Cross Sections



US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

CIVIL
PROPOSED RESTORATION AND TOP OF REPOSITORY GRADES

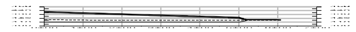
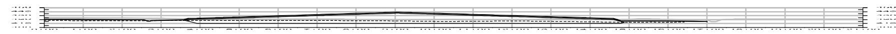
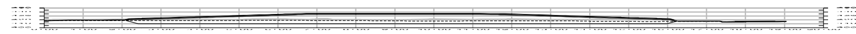
ch2m

NO.	DATE	REVISION	BY	APVD

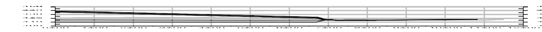
DSGN T OXLEY | DR D SCHAUER | CHK | APVD

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

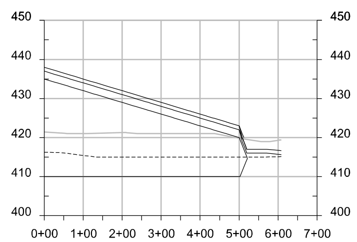
DATE	
PROJ	687729
DWG	
SHEET	of

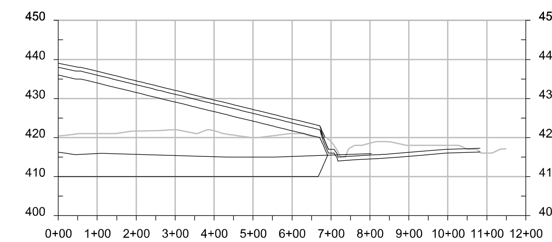




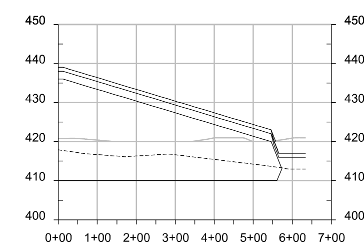
NEW SECTION

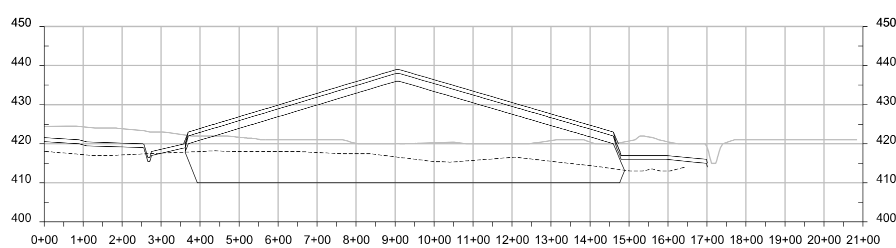


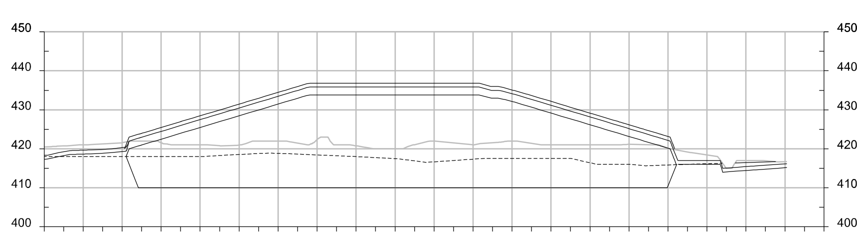
NEW SECTION

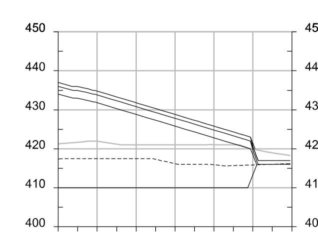


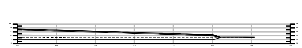


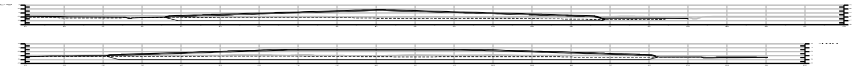
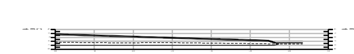
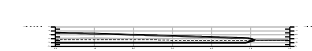


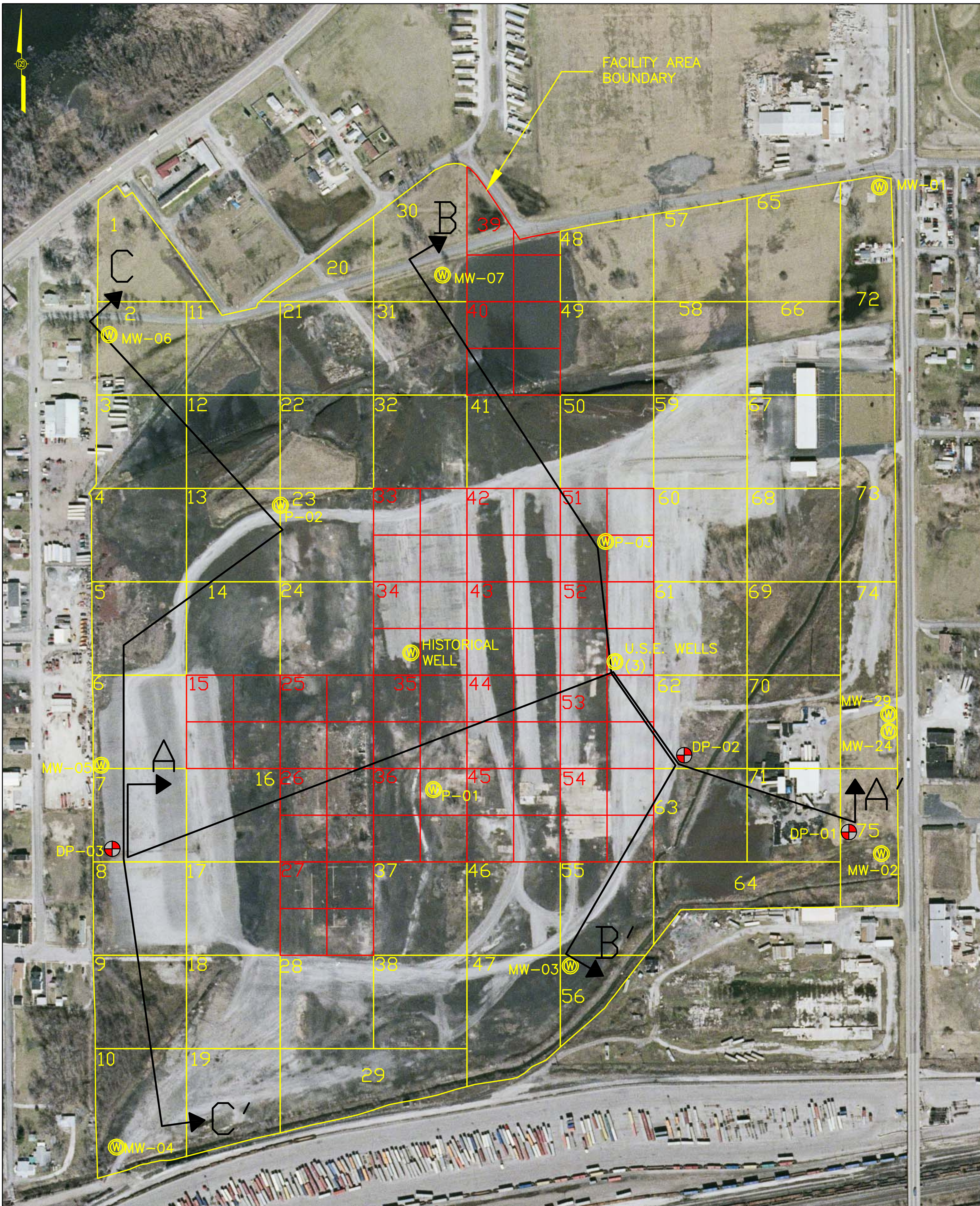










LEGEND

- 300' X 300' SAMPLING GRID LAYOUT
- 150' X 150' SAMPLING GRID LAYOUT
- MONITORING WELL LOCATION
- DEEP SOIL BORING LOCATION

SCALE

0' 300' 600'

1. THE INFORMATION PRESENTED HEREIN IS CONFIDENTIAL IN NATURE AND IS NOT TO BE REPRODUCED OR RE-USED WITHOUT THE EXPRESSED WRITTEN PERMISSION OF ENTACT.
2. 2005 ORTHO-RECTIFIED AERIAL PHOTOGRAPH PROVIDED BY SURDEX, CHESTERFIELD, MO.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION
1	12/15/08	MMC	PT	PT	ISSUED FOR FINAL RI REPORT
0	08/07/08	MMC	PT	PT	ISSUED FOR DRAFT RI REPORT

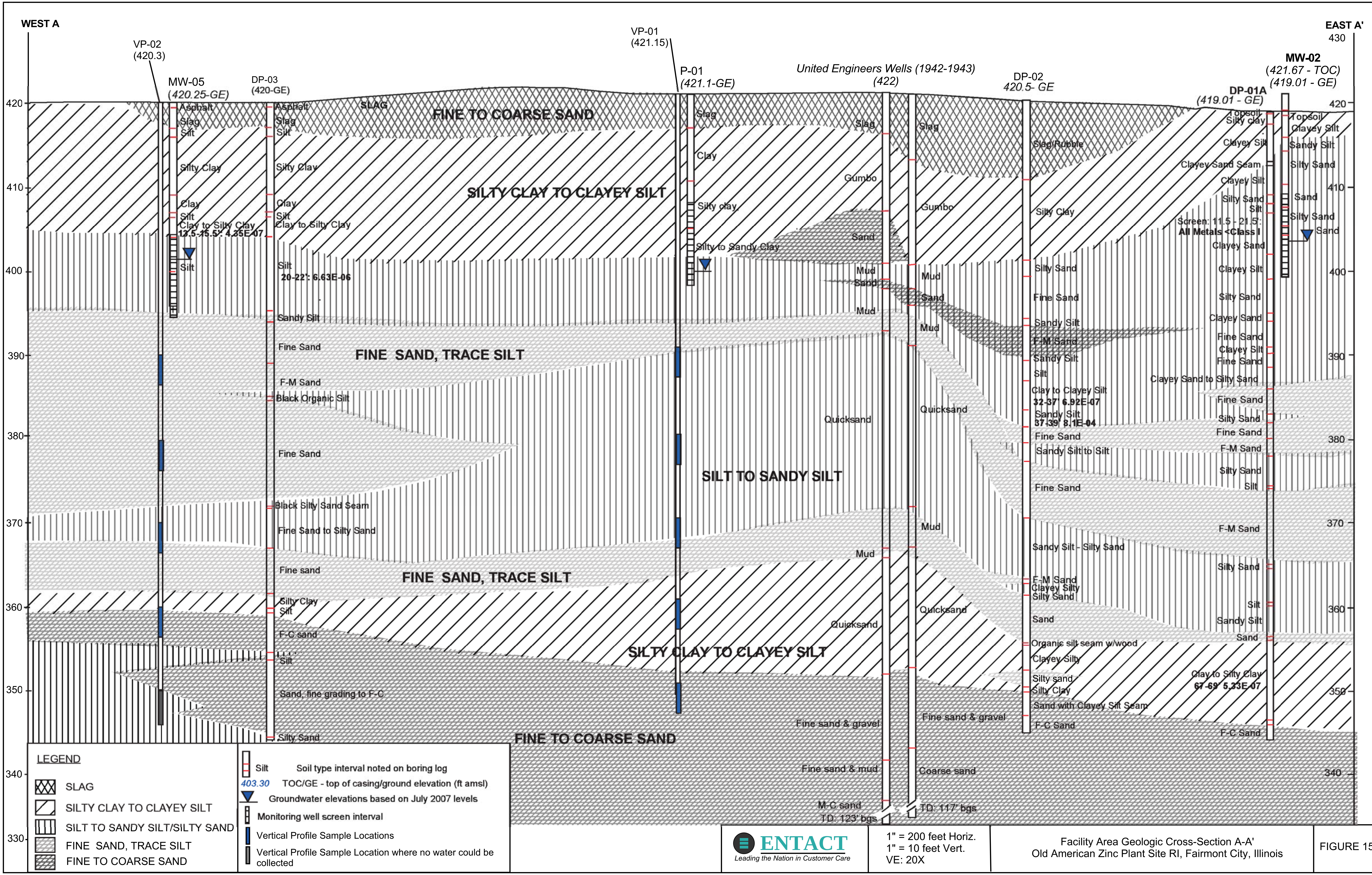
ENTACT

1010 EXECUTIVE COURT, Suite 280
WESTMONT, ILLINOIS 60559
P: 630-986-2900 F: 630-986-0653

DRAWING NAME
DEEP BORING LOCATIONS AND GEOLOGIC CROSS-SECTION LINES A-A', B-B', C-C'

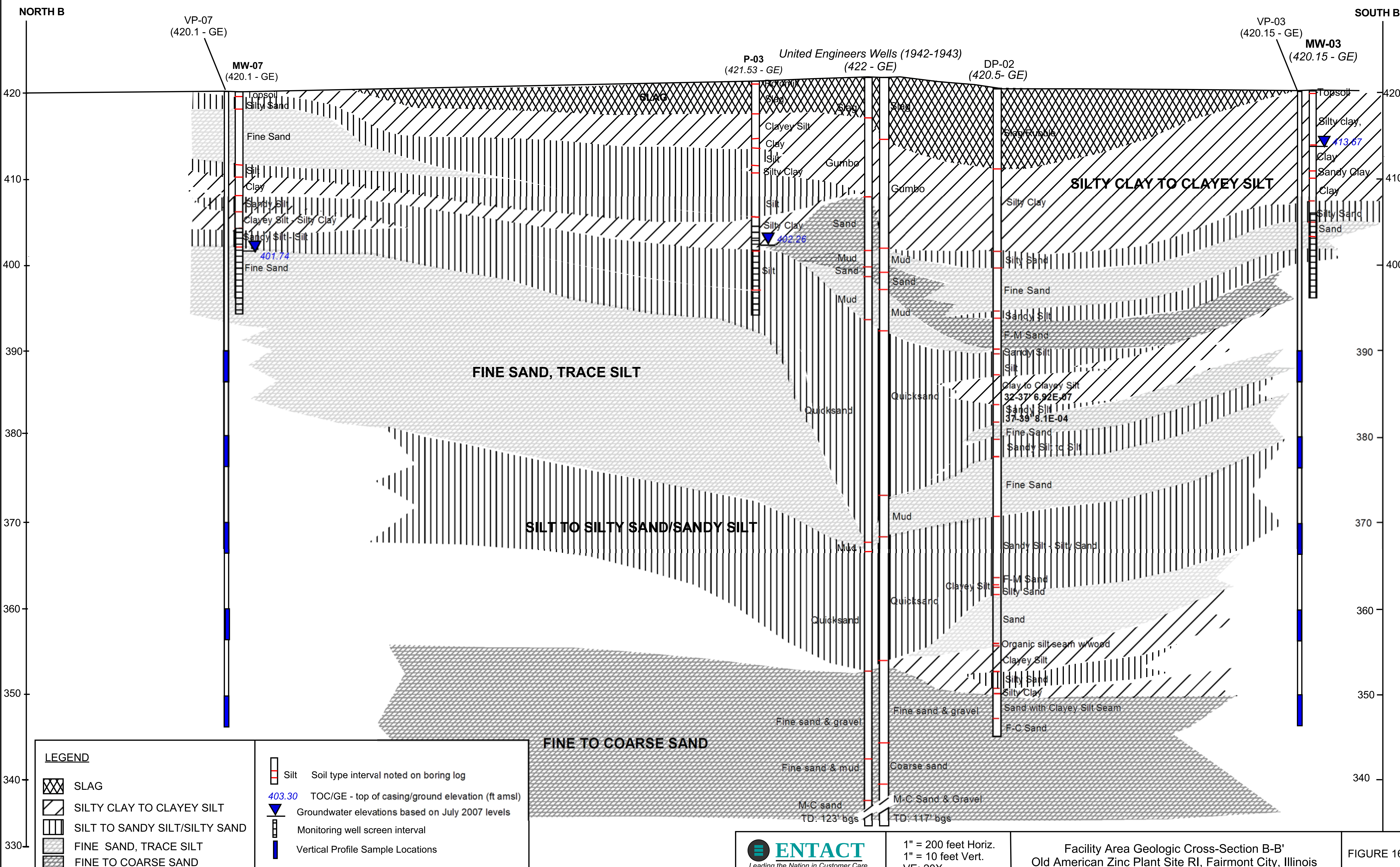
PROJECT NAME & LOCATION
AMERICAN ZINC RIFS
FAIRMONT CITY, ILLINOIS

DRAWN BY	M. CARLSON	APPROVED BY	P. THOMSON	REVISION	SHEET NO.
DATE	01-16-06	DATE	01-16-06	1	1 OF 1
PROJECT NO.	C1727	FIGURE NO.	10		



Facility Area Geologic Cross-Section A-A'
Old American Zinc Plant Site RI, Fairmont City, Illinois

FIGURE 15

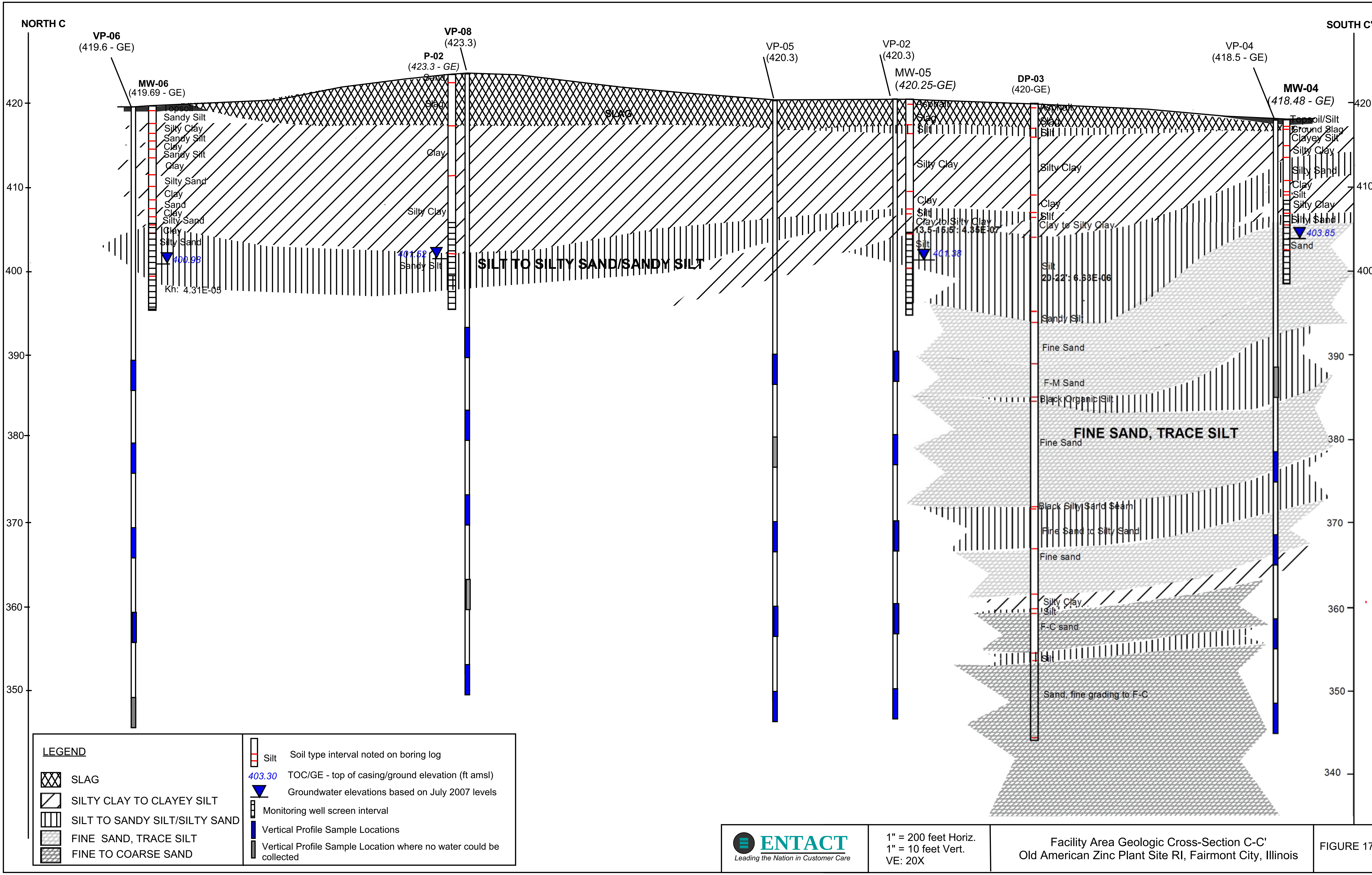


ENTACT
Leading the Nation in Customer Care

1" = 200 feet Horiz.
1" = 10 feet Vert.
VE: 20X

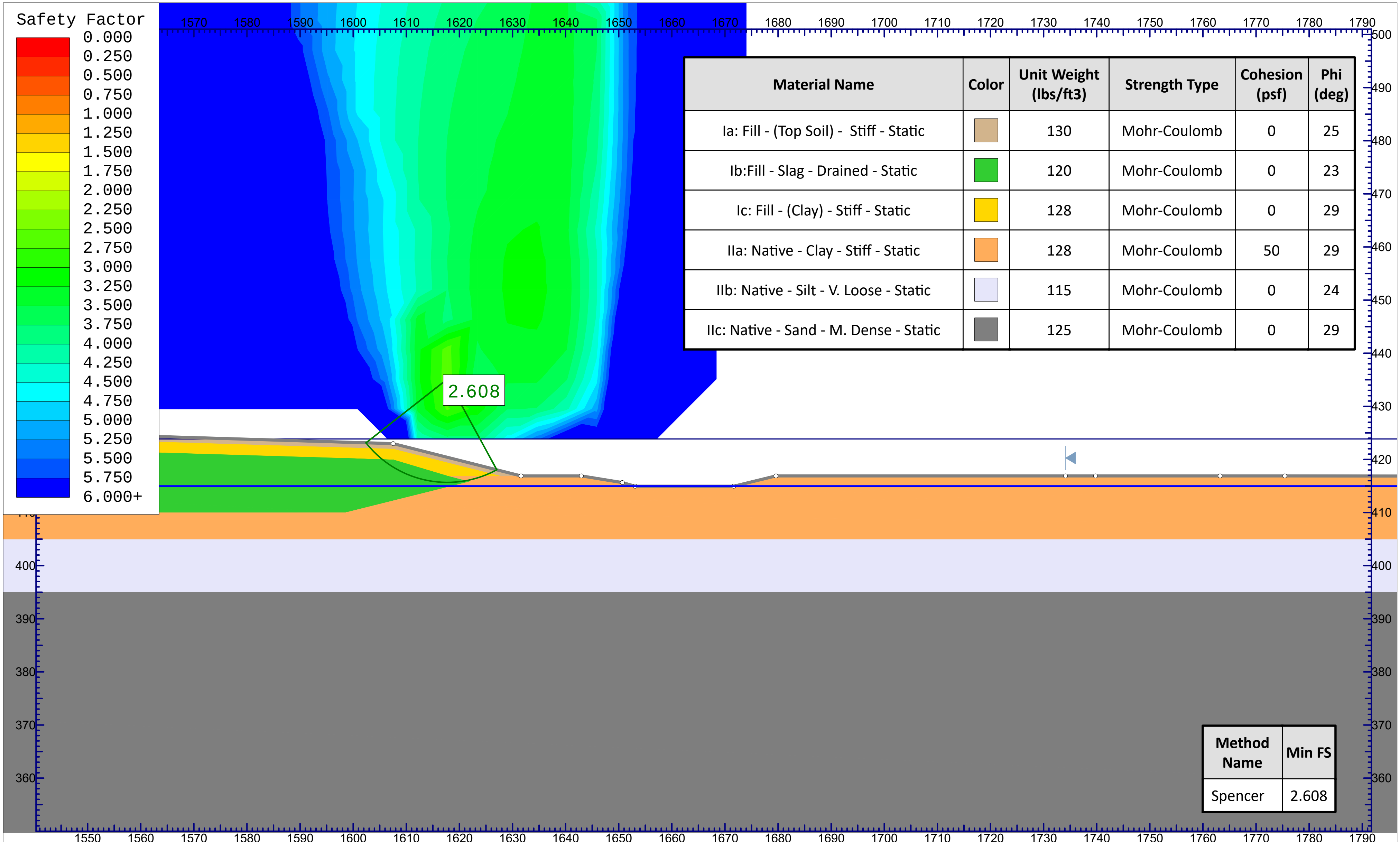
Facility Area Geologic Cross-Section B-B'
Old American Zinc Plant Site RI, Fairmont City, Illinois

FIGURE 16


NORTH C
SOUTH C'
VP-06
(419.6 - GE)
MW-06
(419.69 - GE)
VP-08
(423.3)
P-02
(423.3 - GE)
VP-05
(420.3)
VP-02
(420.3)
MW-05
(420.25-GE)
DP-03
(420-GE)
VP-04
(418.5 - GE)
MW-04
(418.48 - GE)
420
410
400
390
380
370
360
350
340
Topsoil
Sandy Silt
Silty Clay
Sandy Silt
Clay
Sandy Silt
Clay
Silty Sand
Clay
Sand
Clay
Silty Sand
Clay
Silty Sand
400.98
Kh: 4.31E-05
Sand
Slag
Clay
Silty Clay
401.52
Sandy Silt
SLAG
SILT TO SILTY SAND/SANDY SILT
Asphalt
Slag
Silt
Silty Clay
Clay
Silt
Clay to Silty Clay
13.5-15.5': 4.35E-07
Silt
401.38
Silt
20-22': 6.63E-06
Sandy Silt
Fine Sand
F-M Sand
Black Organic Silt
Fine Sand
Black Silty Sand Seam
Fine Sand to Silty Sand
Fine sand
Silty Clay
Silt
F-C sand
Silt
Sand, fine grading to F-C
FINE SAND, TRACE SILT
Topsoil/Silt
Ground Slag
Clayey Silt
Silty Clay
Silty Sand
Clay
Silt
Silty Clay
Silty Sand
403.85
Sand
LEGEND
SLAG
SILTY CLAY TO CLAYEY SILT
SILT TO SANDY SILT/SILTY SAND
FINE SAND, TRACE SILT
FINE TO COARSE SAND
Silt
Soil type interval noted on boring log
403.30
TOC/GE - top of casing/ground elevation (ft amsl)
Groundwater elevations based on July 2007 levels
Monitoring well screen interval
Vertical Profile Sample Locations
Vertical Profile Sample Location where no water could be collected
ENTACT
Leading the Nation in Customer Care
1" = 200 feet Horiz.
1" = 10 feet Vert.
VE: 20X
Facility Area Geologic Cross-Section C-C'
Old American Zinc Plant Site RI, Fairmont City, Illinois
FIGURE 17

Attachment B

Global Stability Analyses



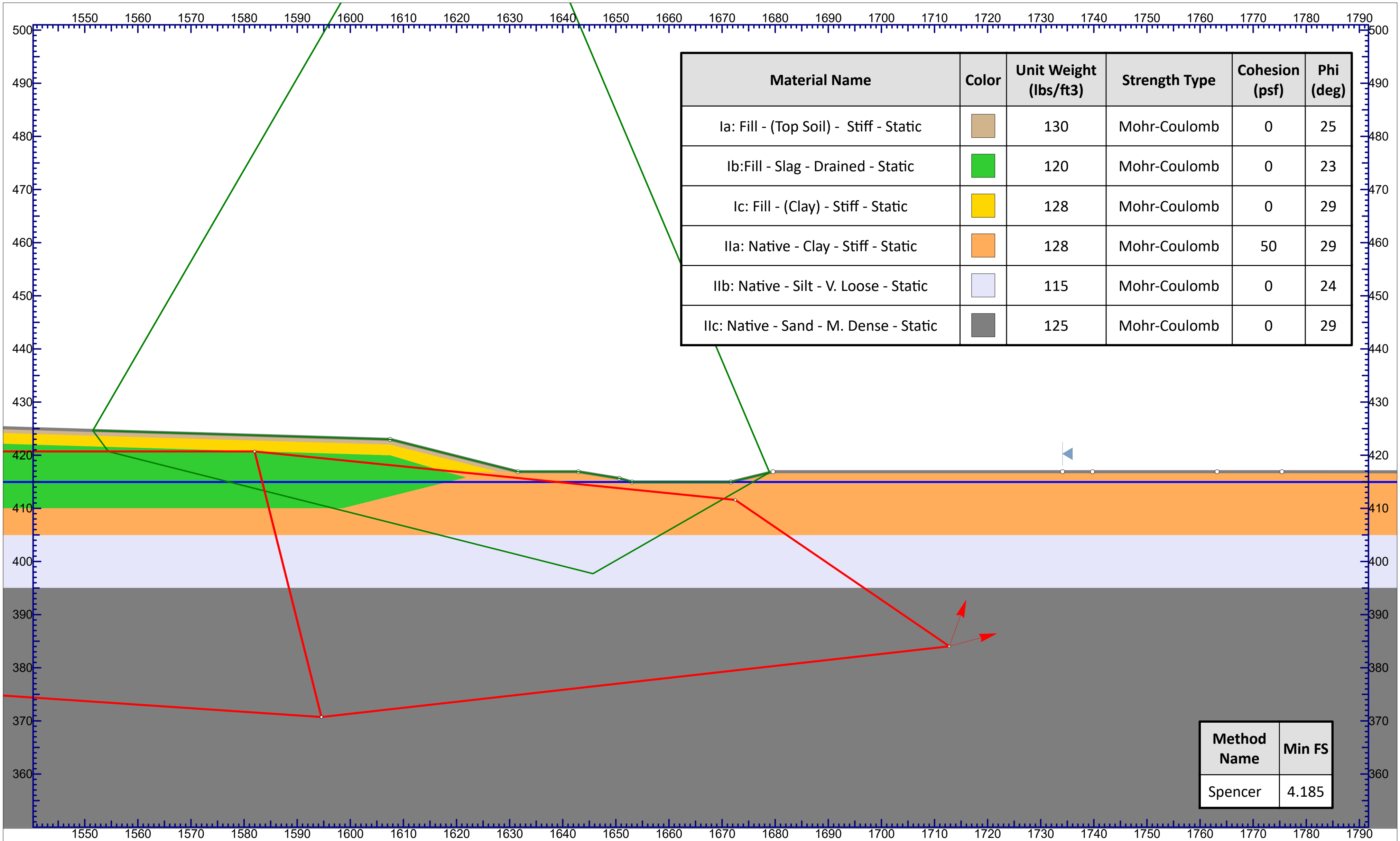
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Static		130	Mohr-Coulomb	0	25
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
Ic: Fill - (Clay) - Stiff - Static		128	Mohr-Coulomb	0	29
IIa: Native - Clay - Stiff - Static		128	Mohr-Coulomb	50	29
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29

Method Name	Min FS
Spencer	2.608

ch2m SM

SLIDEINTERPRET 7.032

Project	Old American Zinc		
Analysis Description	Section A-Drained-Static - Circular		
Drawn By P. Toloza	*Scale* 1:300	*Company*	CH2M
Date 03-27-2018		*File Name*	OAZ_New Section A.slmd

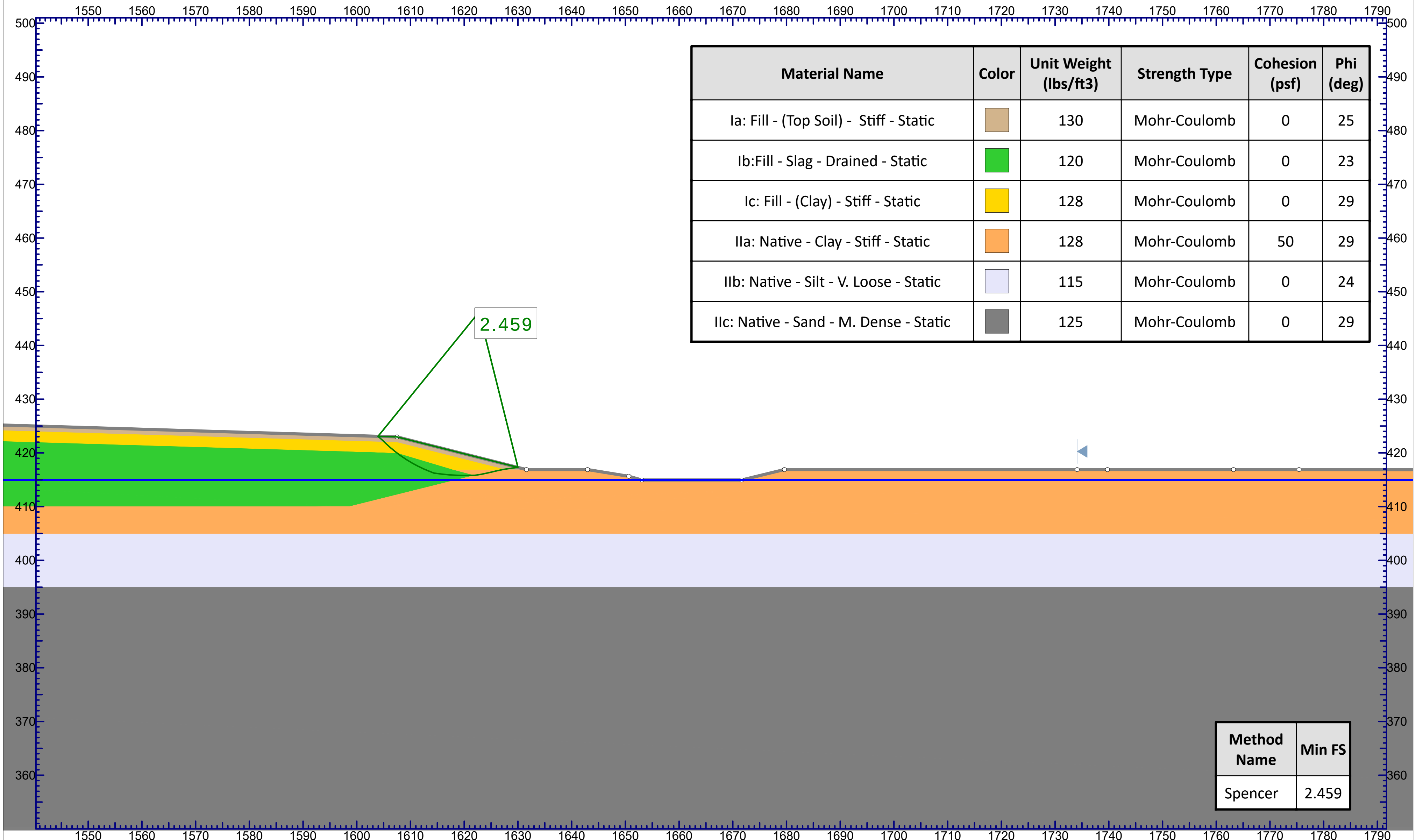


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Static		130	Mohr-Coulomb	0	25
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
Ic: Fill - (Clay) - Stiff - Static		128	Mohr-Coulomb	0	29
IIa: Native - Clay - Stiff - Static		128	Mohr-Coulomb	50	29
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29

Method Name	Min FS
Spencer	4.185

SLIDEINTERPRET 7.032

Project	Old American Zinc
Analysis Description	Section A-Drained-Static - Block
Drawn By	P. Toloza
Scale	1:300
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A.slmd

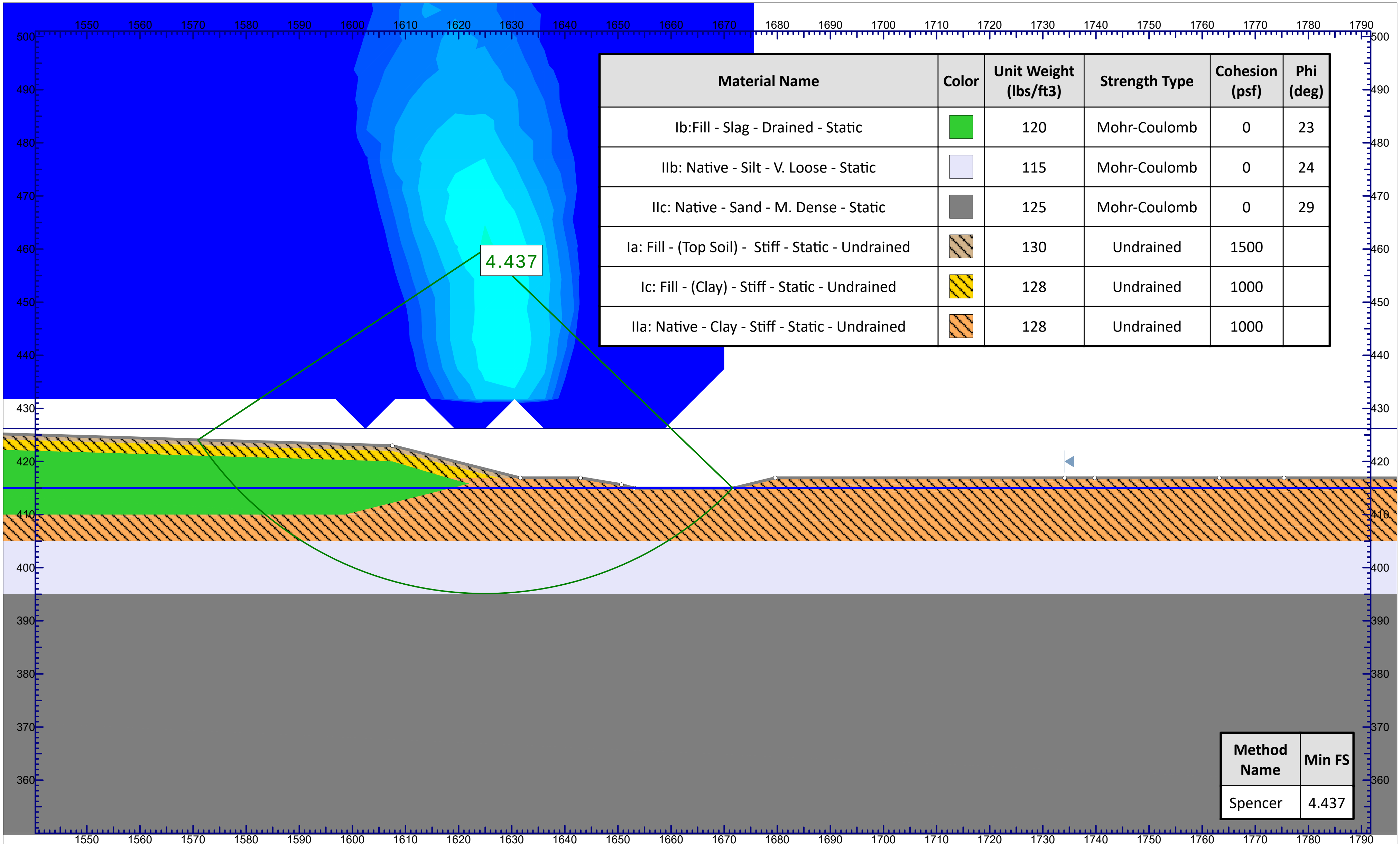


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Static		130	Mohr-Coulomb	0	25
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
Ic: Fill - (Clay) - Stiff - Static		128	Mohr-Coulomb	0	29
IIa: Native - Clay - Stiff - Static		128	Mohr-Coulomb	50	29
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29

Method Name	Min FS
Spencer	2.459

Project	Old American Zinc
Analysis Description	Section A-Drained-Static - Non-Circular 2
Drawn By	P. Toloza
Scale	1:300
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A.slmd

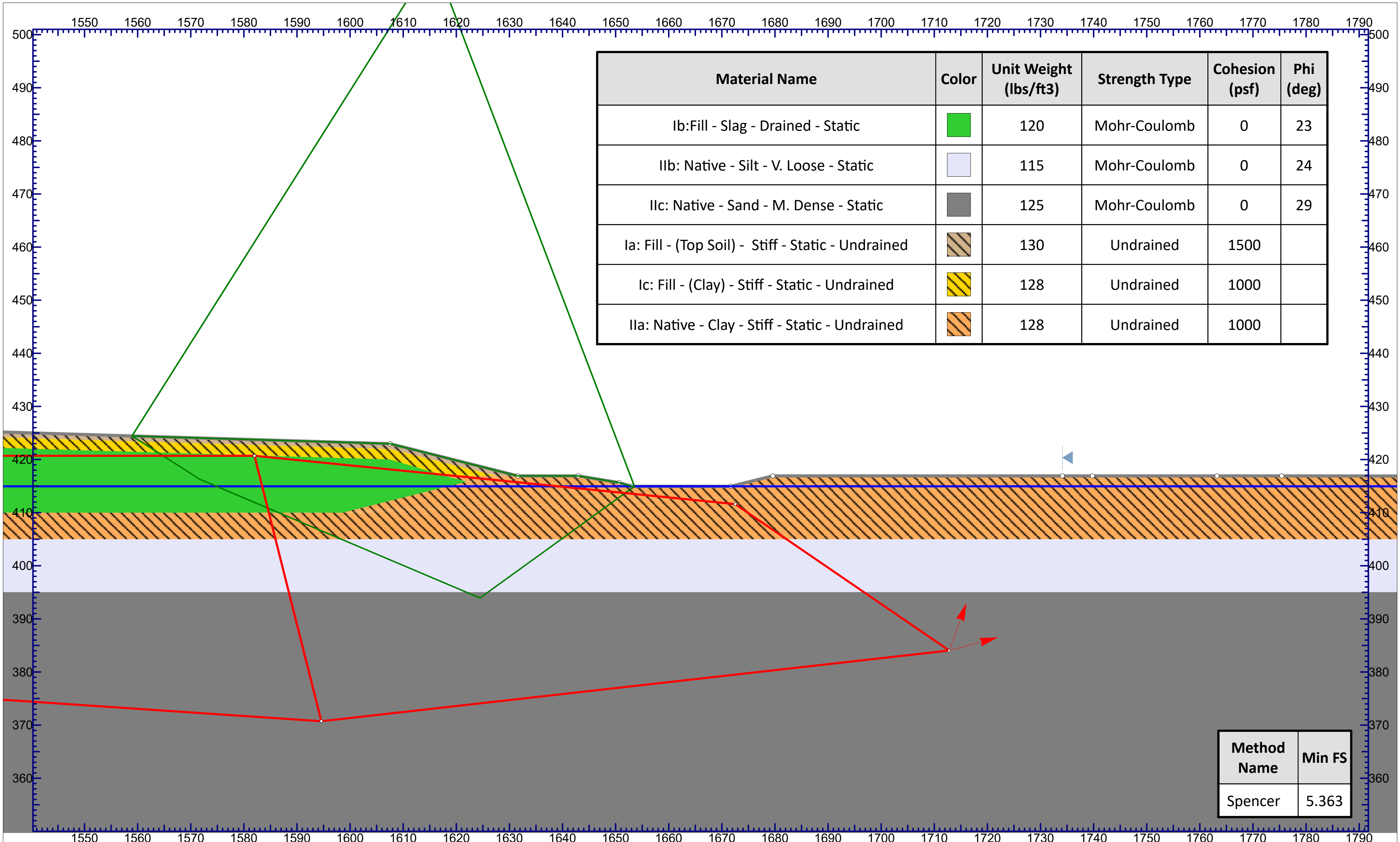
SLIDEINTERPRET 7.032



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29
Ia: Fill - (Top Soil) - Stiff - Static - Undrained		130	Undrained	1500	
Ic: Fill - (Clay) - Stiff - Static - Undrained		128	Undrained	1000	
IIa: Native - Clay - Stiff - Static - Undrained		128	Undrained	1000	

Method Name	Min FS
Spencer	4.437

ch2m	Project: Old American Zinc		
	Analysis Description: Section A-Undrained-Static - Circular		
	Drawn By: P. Toloza	Scale: 1:300	Company: CH2M
SLIDEINTERPRET 7.034	Date: 03-27-2018		File Name: OAZ_New Section A.slmd



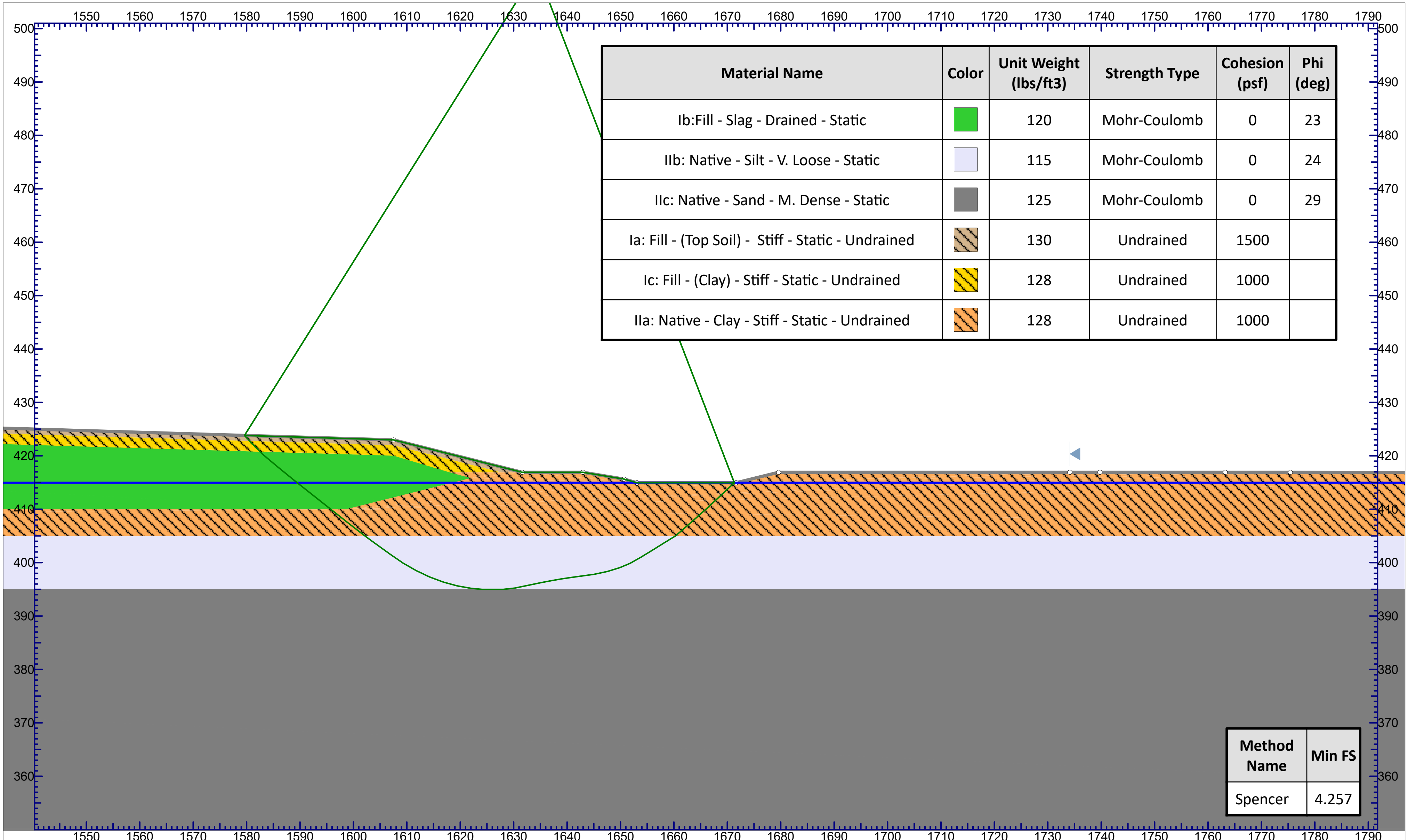
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29
Ia: Fill - (Top Soil) - Stiff - Static - Undrained		130	Undrained	1500	
Ic: Fill - (Clay) - Stiff - Static - Undrained		128	Undrained	1000	
IIa: Native - Clay - Stiff - Static - Undrained		128	Undrained	1000	

Method Name	Min FS
Spencer	5.363

ch2m SM

SLIDEINTERPRET 7.034

Project	Old American Zinc
Analysis Description	Section A-Undrained-Static - Block
Drawn By	P. Toloza
Scale	1:300
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A.slmd

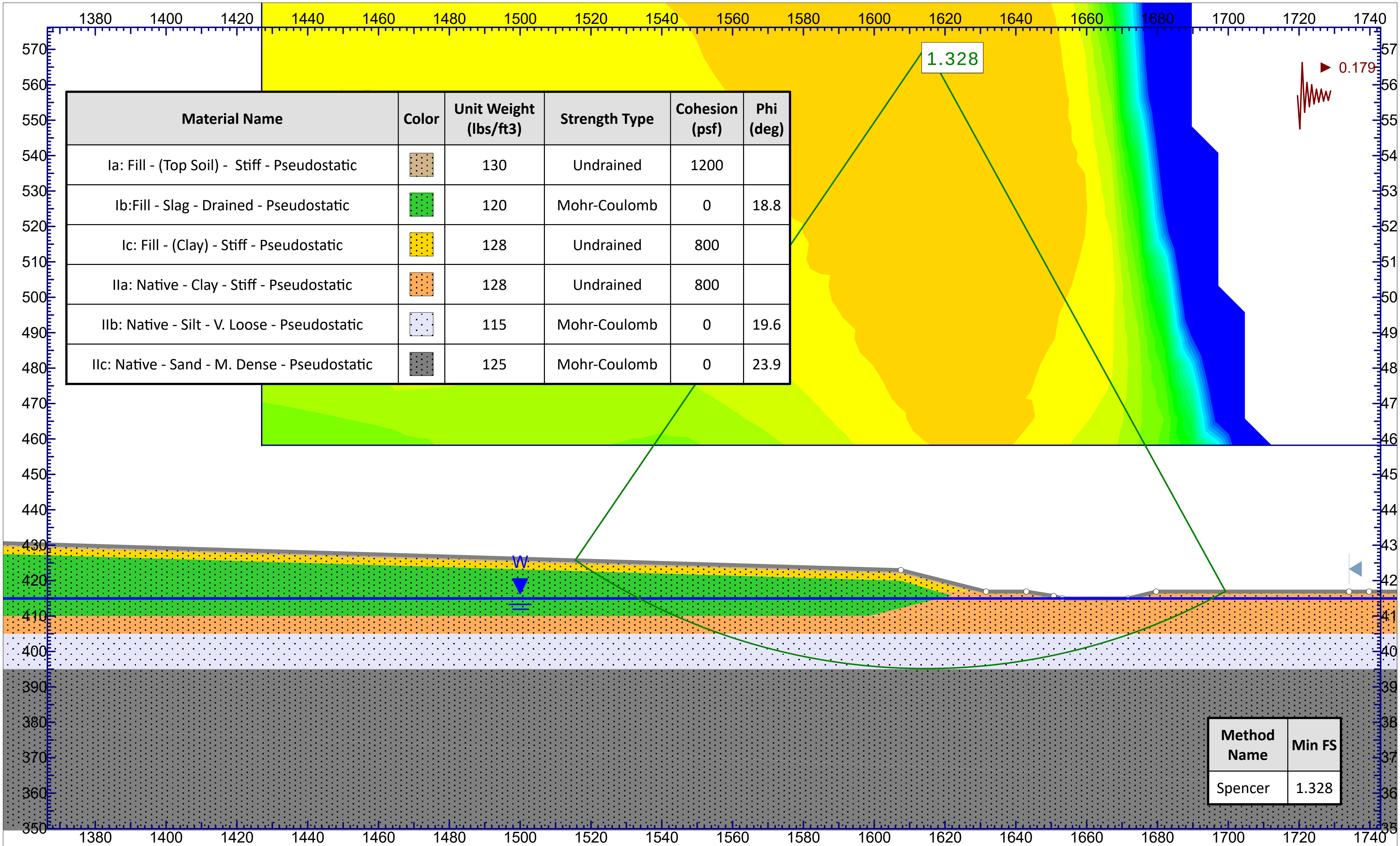


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ib:Fill - Slag - Drained - Static		120	Mohr-Coulomb	0	23
IIb: Native - Silt - V. Loose - Static		115	Mohr-Coulomb	0	24
IIc: Native - Sand - M. Dense - Static		125	Mohr-Coulomb	0	29
Ia: Fill - (Top Soil) - Stiff - Static - Undrained		130	Undrained	1500	
Ic: Fill - (Clay) - Stiff - Static - Undrained		128	Undrained	1000	
IIa: Native - Clay - Stiff - Static - Undrained		128	Undrained	1000	

Method Name	Min FS
Spencer	4.257

Project	Old American Zinc
Analysis Description	Section A-Undrained-Static - Non-Circular 2
Drawn By	P. Toloza
Scale	1:300
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A.slmd

SLIDEINTERPRET 7.034



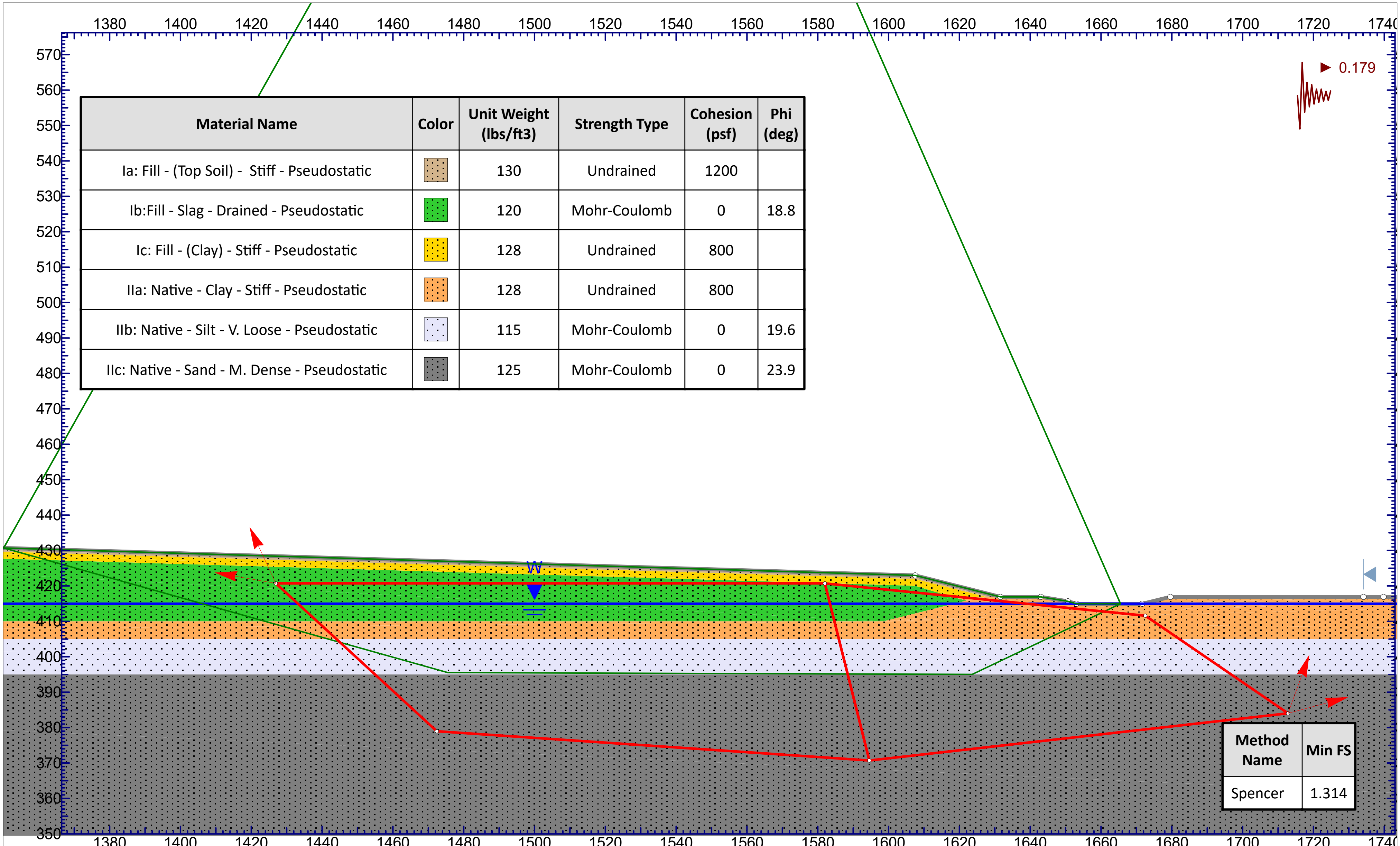
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Pseudostatic		130	Undrained	1200	
Ib:Fill - Slag - Drained - Pseudostatic		120	Mohr-Coulomb	0	18.8
Ic: Fill - (Clay) - Stiff - Pseudostatic		128	Undrained	800	
IIa: Native - Clay - Stiff - Pseudostatic		128	Undrained	800	
IIb: Native - Silt - V. Loose - Pseudostatic		115	Mohr-Coulomb	0	19.6
IIc: Native - Sand - M. Dense - Pseudostatic		125	Mohr-Coulomb	0	23.9

Method Name	Min FS
Spencer	1.328

ch2m SM

SLIDEINTERPRET 7.033

Project	Old American Zinc		
Analysis Description	Section A-Undrained-Pseudostatic - Circular		
Drawn By P. Toloza	*Scale* 1:450	*Company*	CH2M
Date	03-27-2018	*File Name*	OAZ_New Section A.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Pseudostatic		130	Undrained	1200	
Ib:Fill - Slag - Drained - Pseudostatic		120	Mohr-Coulomb	0	18.8
Ic: Fill - (Clay) - Stiff - Pseudostatic		128	Undrained	800	
IIa: Native - Clay - Stiff - Pseudostatic		128	Undrained	800	
IIb: Native - Silt - V. Loose - Pseudostatic		115	Mohr-Coulomb	0	19.6
IIc: Native - Sand - M. Dense - Pseudostatic		125	Mohr-Coulomb	0	23.9

Method Name	Min FS
Spencer	1.314

ch2m

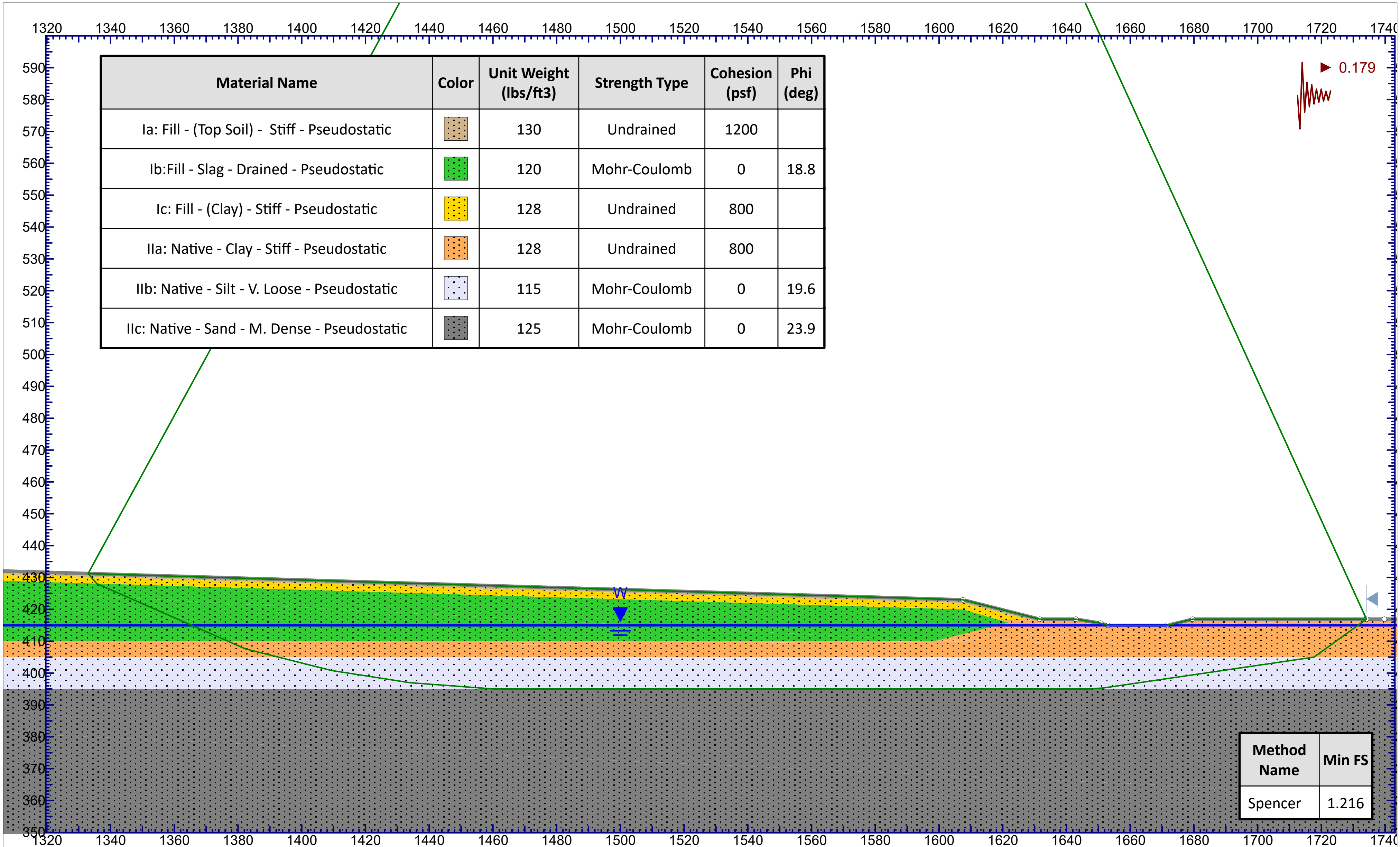
SLIDEINTERPRET 7.033

Project: Old American Zinc

Analysis Description: Section A-Undrained-Pseudostatic - Block

Drawn By: P. Toloza | *Scale*: 1:450 | *Company*: CH2M

Date: 03-27-2018 | *File Name*: OAZ_New Section A.slmd



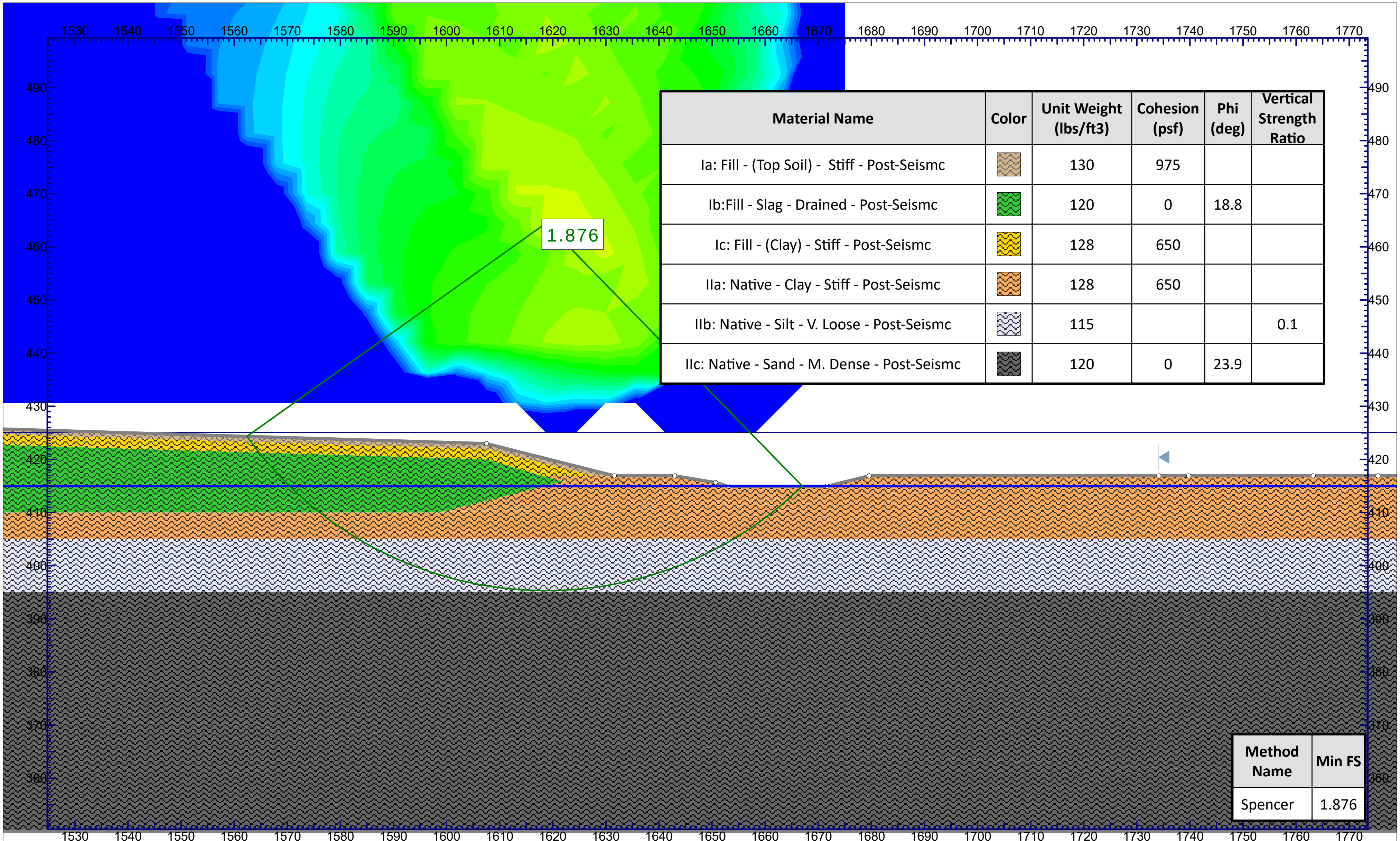
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Ia: Fill - (Top Soil) - Stiff - Pseudostatic		130	Undrained	1200	
Ib:Fill - Slag - Drained - Pseudostatic		120	Mohr-Coulomb	0	18.8
Ic: Fill - (Clay) - Stiff - Pseudostatic		128	Undrained	800	
IIa: Native - Clay - Stiff - Pseudostatic		128	Undrained	800	
IIb: Native - Silt - V. Loose - Pseudostatic		115	Mohr-Coulomb	0	19.6
IIc: Native - Sand - M. Dense - Pseudostatic		125	Mohr-Coulomb	0	23.9

Method Name	Min FS
Spencer	1.216

ch2m SM

SLIDEINTERPRET 7.033

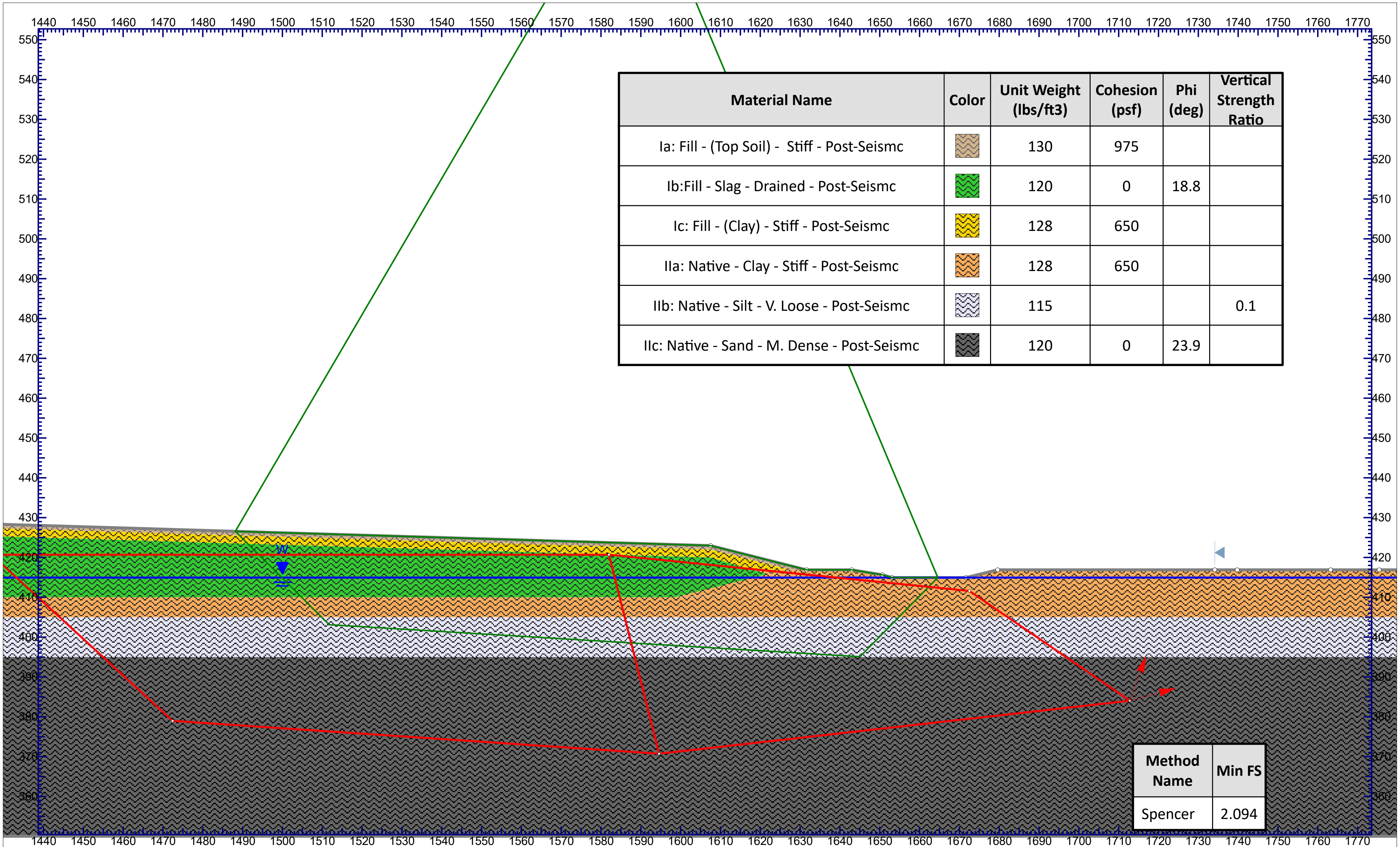
Project	Old American Zinc
Analysis Description	Section A-Undrained-Pseudostatic - Non-Circular 1
Drawn By	P. Toloza
Scale	1:500
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio
Ia: Fill - (Top Soil) - Stiff - Post-Seismc		130	975		
Ib:Fill - Slag - Drained - Post-Seismc		120	0	18.8	
Ic: Fill - (Clay) - Stiff - Post-Seismc		128	650		
IIa: Native - Clay - Stiff - Post-Seismc		128	650		
IIb: Native - Silt - V. Loose - Post-Seismc		115			0.1
IIc: Native - Sand - M. Dense - Post-Seismc		120	0	23.9	

Method Name	Min FS
Spencer	1.876

ch2m SM	*Project* Old American Zinc		
	Analysis Description Section A-Post-Seismic Residual - Circular		
	Drawn By P. Toloza	*Scale* 1:300	*Company* CH2M
SLIDEINTERPRET 7.033	*Date* 03-27-2018		*File Name* OAZ_New Section A_Post seimic.slmd



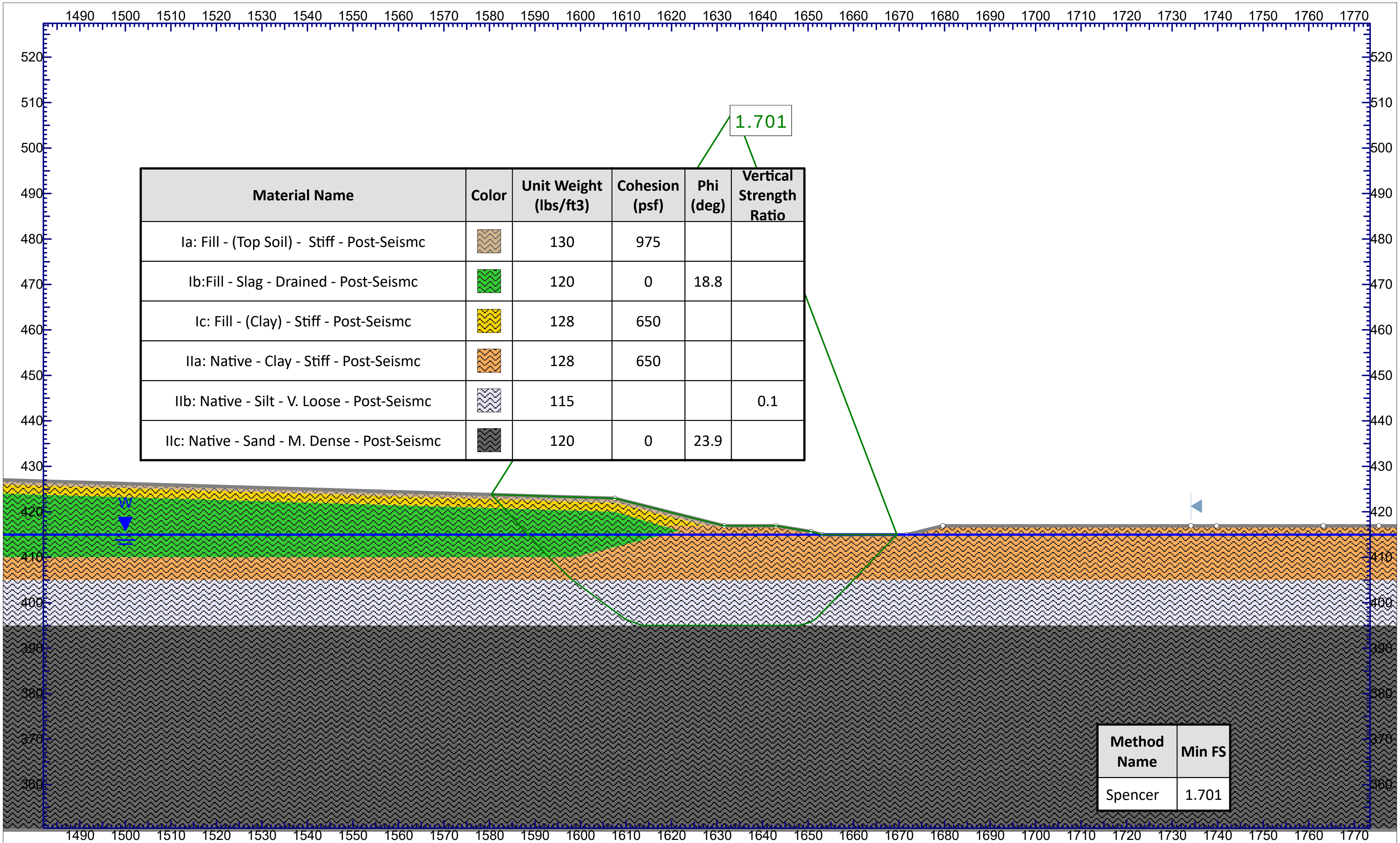
Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio
Ia: Fill - (Top Soil) - Stiff - Post-Seismc		130	975		
Ib:Fill - Slag - Drained - Post-Seismc		120	0	18.8	
Ic: Fill - (Clay) - Stiff - Post-Seismc		128	650		
IIa: Native - Clay - Stiff - Post-Seismc		128	650		
IIb: Native - Silt - V. Loose - Post-Seismc		115			0.1
IIc: Native - Sand - M. Dense - Post-Seismc		120	0	23.9	

Method Name	Min FS
Spencer	2.094

ch2m SM

SLIDEINTERPRET 7.033

Project	Old American Zinc
Analysis Description	Section A-Post-Seismic Residual - Block
Drawn By	P. Toloza
Scale	1:400
Company	CH2M
Date	03-27-2018
File Name	OAZ_New Section A_Post seimic.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio
Ia: Fill - (Top Soil) - Stiff - Post-Seismc		130	975		
Ib:Fill - Slag - Drained - Post-Seismc		120	0	18.8	
Ic: Fill - (Clay) - Stiff - Post-Seismc		128	650		
IIa: Native - Clay - Stiff - Post-Seismc		128	650		
IIb: Native - Silt - V. Loose - Post-Seismc		115			0.1
IIc: Native - Sand - M. Dense - Post-Seismc		120	0	23.9	

Method Name	Min FS
Spencer	1.701

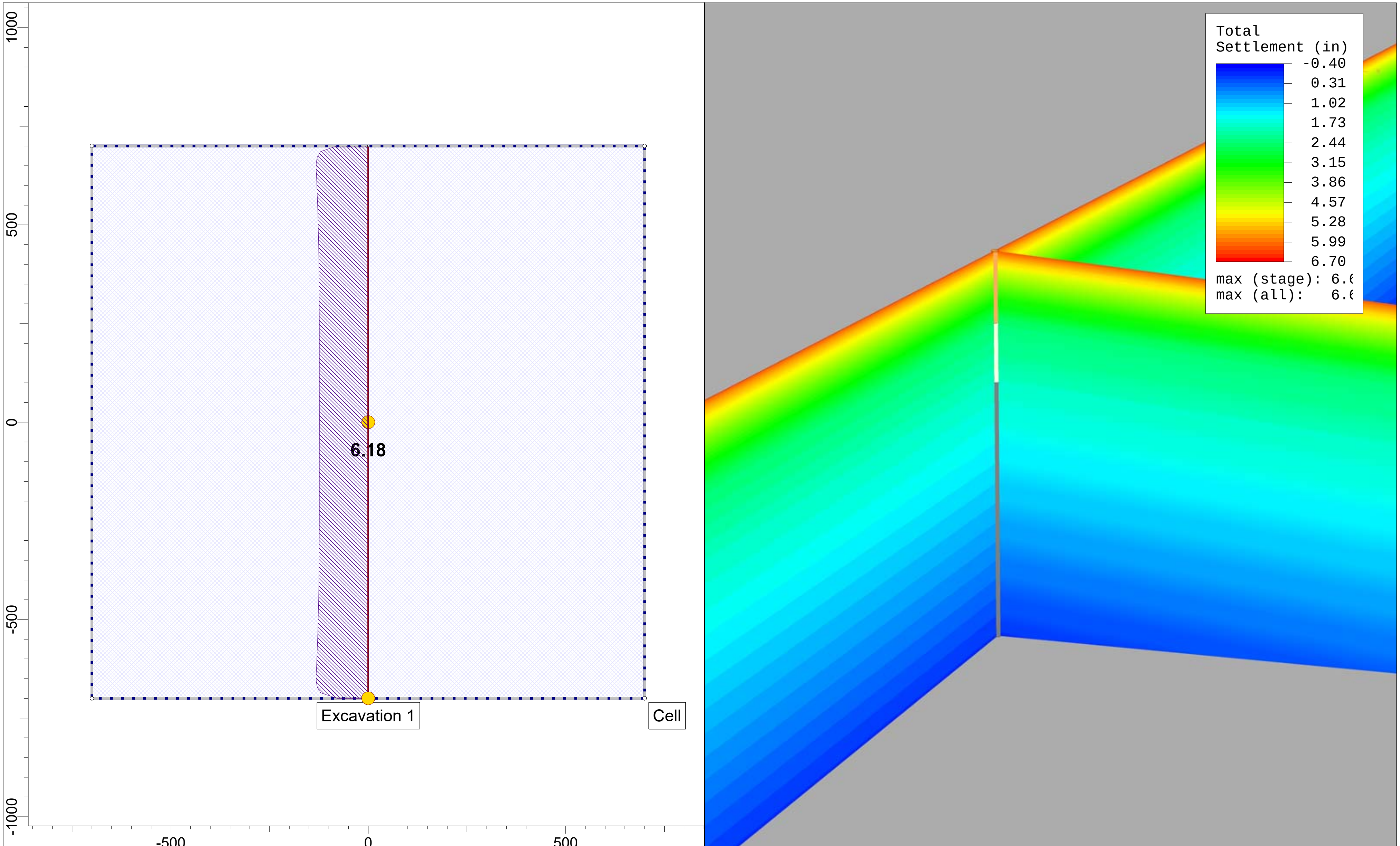
Project	Old American Zinc		
Analysis Description	Section A-Post-Seismic Residual - Non-Circular 1		
Drawn By P. Toloza	*Scale* 1:350	*Company*	CH2M
Date 03-27-2018		*File Name*	OAZ_New Section A_Post seimic.slmd

ch2m SM

SLIDEINTERPRET 7.033

Attachment C

Settlement Analyses



ch2m SM

SETTLE3D 4.016

Project	Old American Zinc		
Analysis Description	Cell		
Drawn By	P. Toloza	*Company*	CH2M
Date	2018-04-16	*File Name*	OAZ_cell.s3z

Settle3D Analysis Information
Old American Zinc

Project Settings

Document Name	OAZ_cell.s3z
Project Title	Old American Zinc
Analysis	Cell
Author	P. Toloza
Company	CH2M
Date Created	2018-04-16
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	months
Permeability Units	inches/minute
Minimum settlement ratio for subgrade modulus	0.9

Calculate settlement with mean stress

Use average properties to calculate layered stresses

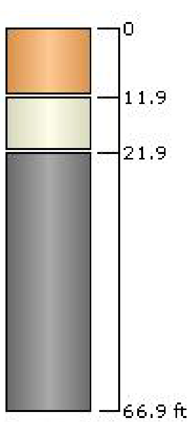
Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	1: Clay (Stiff)	11.9	0	Yes
2	2: Sand/Silt (Loose)	10	11.9	Yes
3	3: Sand/Silt (M. Dense)	45	21.9	No



Soil Properties

Property	1: Clay (Stiff)	2: Sand/Silt (Loose)	3: Sand/Silt (M. Dense)
Color			
Unit Weight [kips/ft^3]	0.129	0.12	0.125
Saturated Unit Weight [kips/ft^3]	0.13	0.125	0.13
Poisson's Ratio	0.35	0.35	0.35
K0	0.607	0.531	0.426
Immediate Settlement	Disabled	Enabled	Enabled
E [ksf]	-	200	320
Eur [ksf]	-	600	960
Primary Consolidation	Enabled	Disabled	Disabled
Material Type	Non-Linear		
Cc	0.5	-	-
Cr	0.05	-	-
e0	0.6569	-	-
Pc [ksf]	4	-	-
Cv [in^2/min]	0.00372	-	-
Cvr [in^2/min]	0.00372	-	-
B-bar	1	-	-
Undrained Su A [kips/ft2]	0	0	0
Undrained Su S	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8
Piezo Line ID	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

ID	Depth (ft)
1	1.941 ft

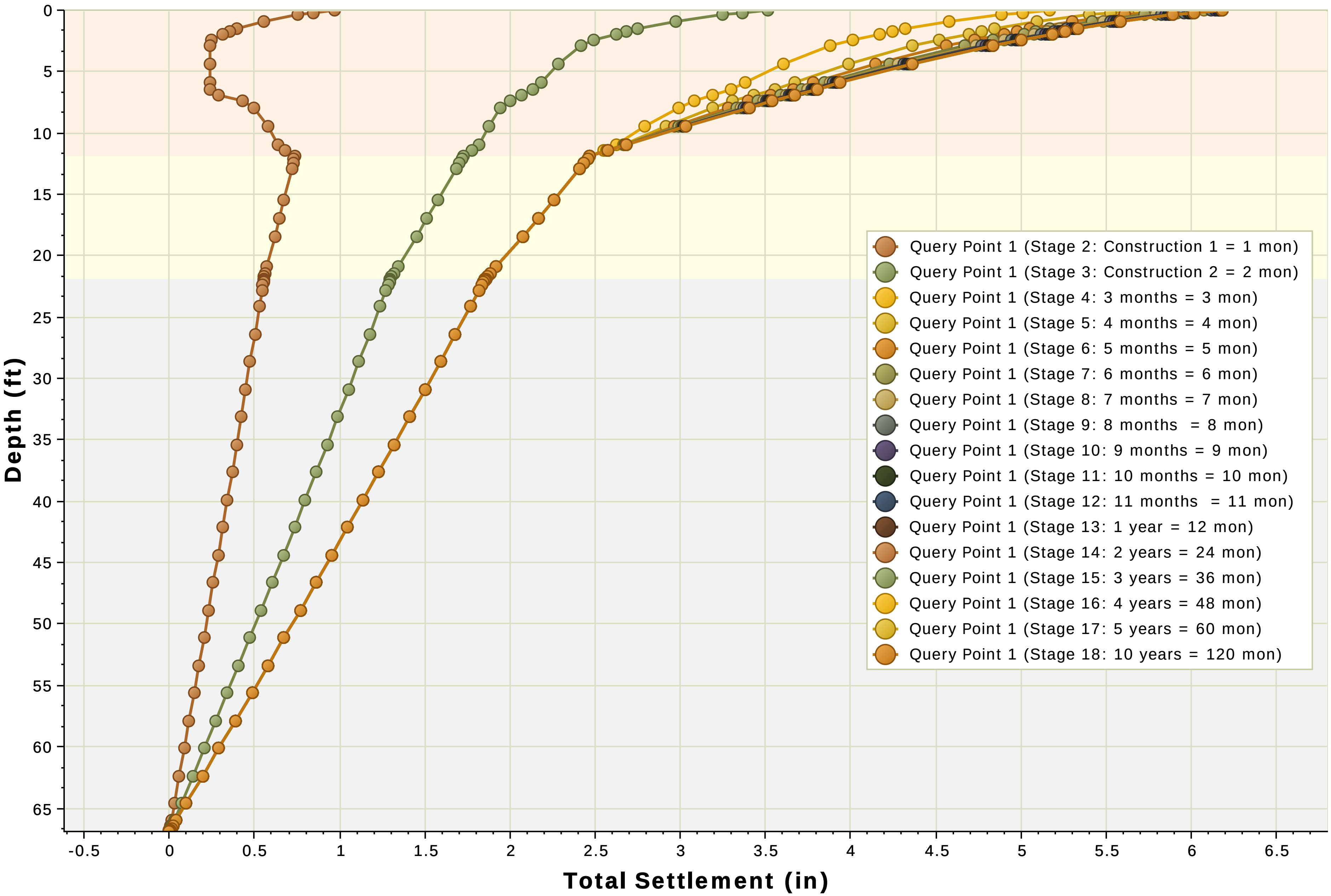
Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Point	0, 0	Auto: 59

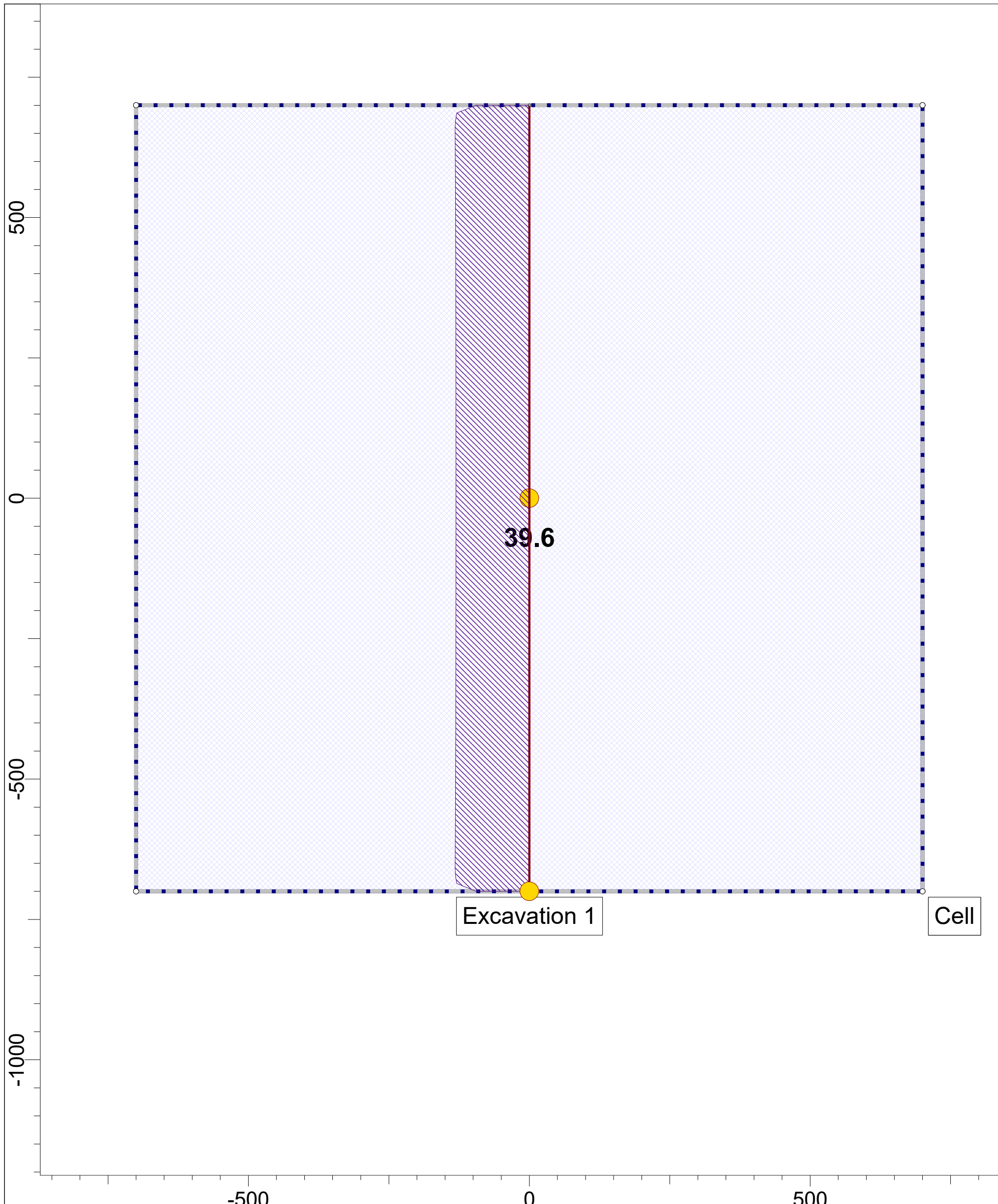
Query Lines

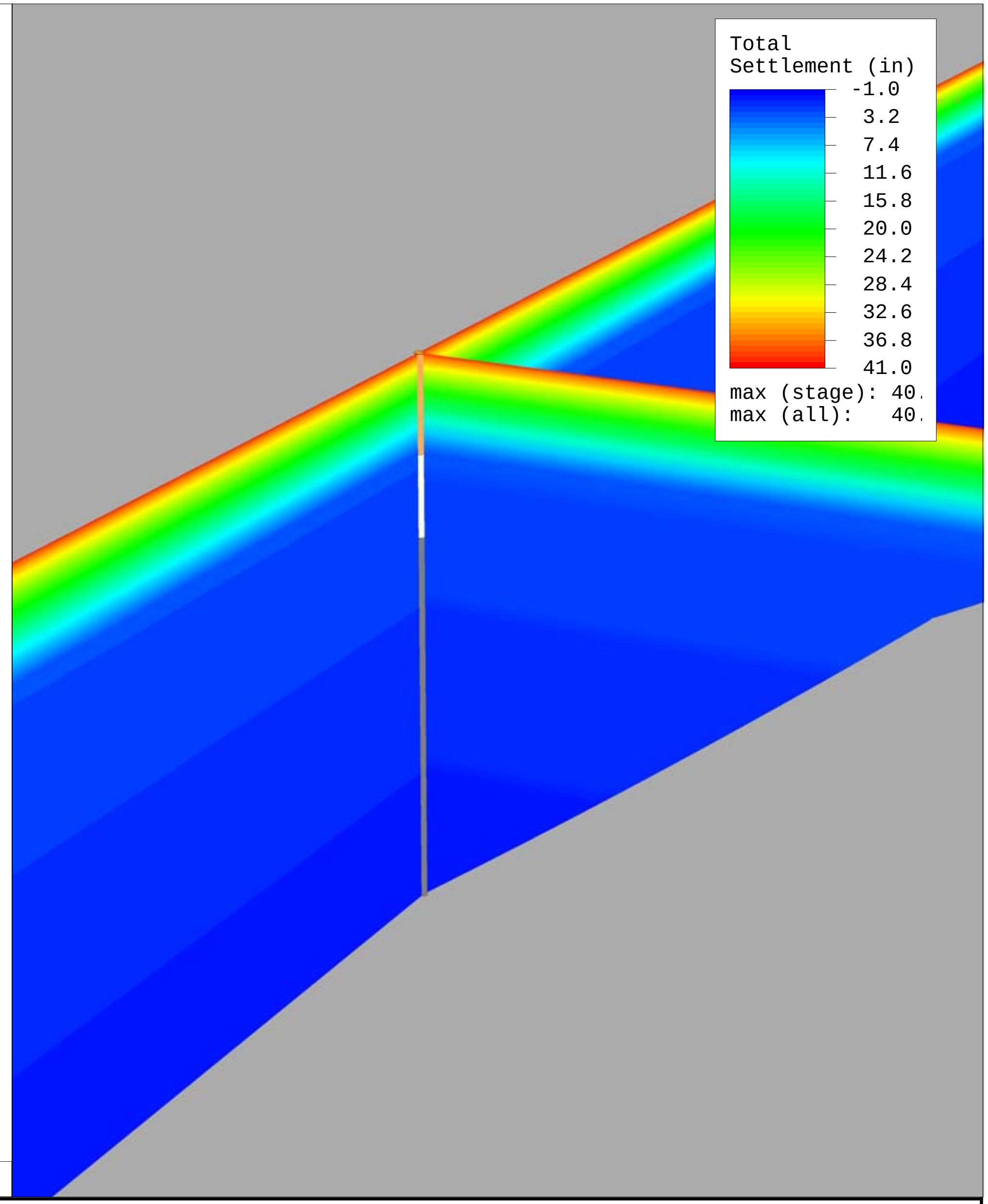
Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Line	0, -700	0, 700	100	Auto: 59

Total Settlement vs. Depth



Reference Stage: None





Project	Old American Zinc
Analysis Description	Cell
Drawn By	P. Toloza
Company	CH2M
Date	2018-04-16
File Name	OAZ_cell_NC.s3z

SETTLE3D 4.016

Settle3D Analysis Information
Old American Zinc

Project Settings

Document Name	OAZ_cell_NC.s3z
Project Title	Old American Zinc
Analysis	Cell
Author	P. Toloza
Company	CH2M
Date Created	2018-04-16
Stress Computation Method	Boussinesq
Time-dependent Consolidation Analysis	
Time Units	months
Permeability Units	inches/minute
Minimum settlement ratio for subgrade modulus	0.9

Calculate settlement with mean stress

Use average properties to calculate layered stresses

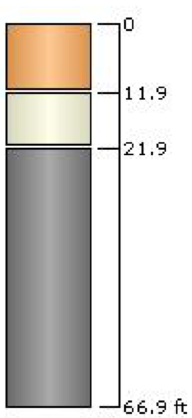
Improve consolidation accuracy

Ignore negative effective stresses in settlement calculations

Soil Layers

Ground Surface Drained: Yes

Layer #	Type	Thickness [ft]	Depth [ft]	Drained at Bottom
1	1: Clay (Stiff)	11.9	0	Yes
2	2: Sand/Silt (Loose)	10	11.9	Yes
3	3: Sand/Silt (M. Dense)	45	21.9	No



Soil Properties

Property	1: Clay (Stiff)	2: Sand/Silt (Loose)	3: Sand/Silt (M. Dense)
Color			
Unit Weight [kips/ft^3]	0.129	0.12	0.125
Saturated Unit Weight [kips/ft^3]	0.13	0.125	0.13
Poisson's Ratio	0.35	0.35	0.35
K0	0.607	0.531	0.426
Immediate Settlement	Disabled	Enabled	Enabled
E [ksf]	-	200	320
Eur [ksf]	-	600	960
Primary Consolidation	Enabled	Disabled	Disabled
Material Type	Non-Linear		
Cc	0.5	-	-
Cr	0.05	-	-
e0	0.6569	-	-
OCR	1	-	-
Cv [in^2/min]	0.00372	-	-
Cvr [in^2/min]	0.00372	-	-
B-bar	1	-	-
Undrained Su A [kips/ft2]	0	0	0
Undrained Su S	0.2	0.2	0.2
Undrained Su m	0.8	0.8	0.8
Piezo Line ID	1	1	1

Groundwater

Groundwater method	Piezometric Lines
Water Unit Weight	0.0624 kips/ft^3

Piezometric Line Entities

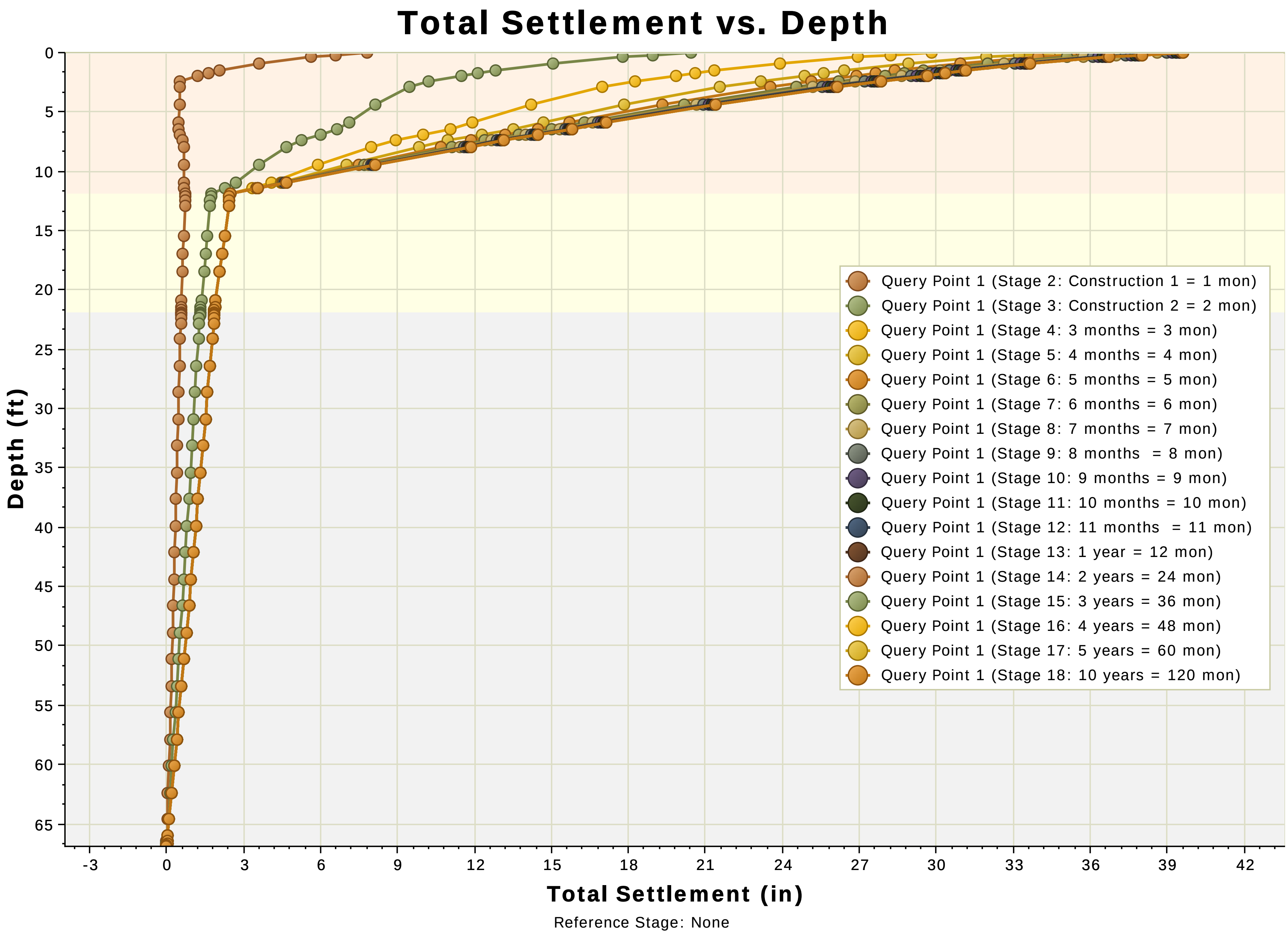
ID	Depth (ft)
1	1.941 ft

Query Points

Point #	Query Point Name	(X,Y) Location	Number of Divisions
1	Point	0, 0	Auto: 59

Query Lines

Line #	Query Line Name	Start Location	End Location	Horizontal Divisions	Vertical Divisions
1	Line	0, -700	0, 700	100	Auto: 59


Total Settlement vs. Depth
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
-3
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
Total Settlement (in)
Query Point 1 (Stage 2: Construction 1 = 1 mon)
Query Point 1 (Stage 3: Construction 2 = 2 mon)
Query Point 1 (Stage 4: 3 months = 3 mon)
Query Point 1 (Stage 5: 4 months = 4 mon)
Query Point 1 (Stage 6: 5 months = 5 mon)
Query Point 1 (Stage 7: 6 months = 6 mon)
Query Point 1 (Stage 8: 7 months = 7 mon)
Query Point 1 (Stage 9: 8 months = 8 mon)
Query Point 1 (Stage 10: 9 months = 9 mon)
Query Point 1 (Stage 11: 10 months = 10 mon)
Query Point 1 (Stage 12: 11 months = 11 mon)
Query Point 1 (Stage 13: 1 year = 12 mon)
Query Point 1 (Stage 14: 2 years = 24 mon)
Query Point 1 (Stage 15: 3 years = 36 mon)
Query Point 1 (Stage 16: 4 years = 48 mon)
Query Point 1 (Stage 17: 5 years = 60 mon)
Query Point 1 (Stage 18: 10 years = 120 mon)
Reference Stage: None

Attachment D

Seismicity Data

Design Maps Summary Report

User–Specified Input

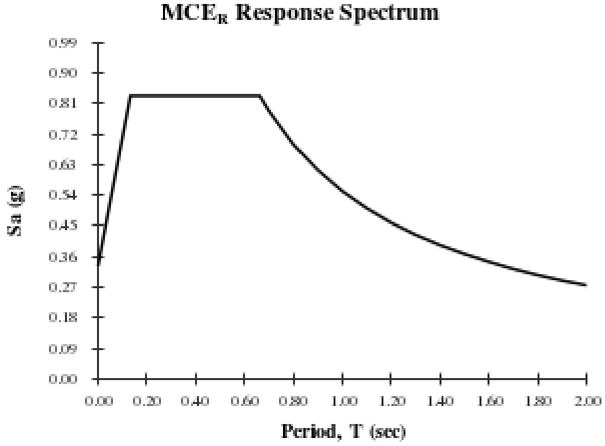
Report Title	Old American Zinc Wed April 18, 2018 19:57:30 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	38.64569°N, 90.10739°W
Site Soil Classification	Site Class E – “Soft Clay Soil”
Risk Category	IV (e.g. essential facilities)

USGS–Provided Output

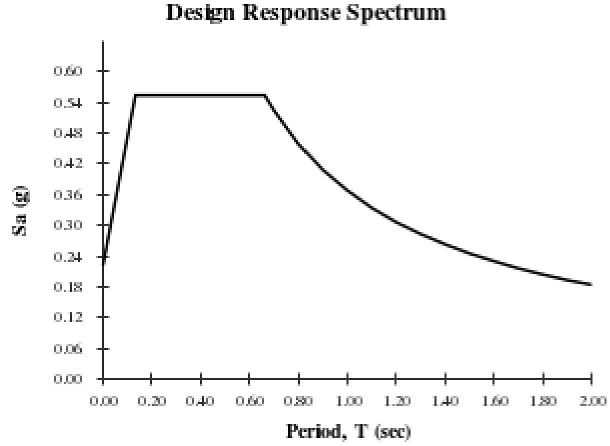
S_S =	0.438 g	S_{MS} =	0.832 g	S_{DS} =	0.554 g
S_1 =	0.167 g	S_{M1} =	0.551 g	S_{D1} =	0.368 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the “2009 NEHRP” building code reference document.

MCE_R Response Spectrum



Design Response Spectrum



For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Design Maps Detailed Report

ASCE 7-10 Standard (38.64569°N, 90.10739°W)

Site Class E – "Soft Clay Soil", Risk Category IV (e.g. essential facilities)

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_S = 0.438 g
From Figure 22-2 [2]	S_1 = 0.167 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class E, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ **or** $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq$ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = E and S_S = 0.438 g, F_a = 1.898

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = E and S_1 = 0.167 g, F_v = 3.299

Equation (11.4–1): $S_{MS} = F_aS_S = 1.898 \times 0.438 = 0.832$ g

Equation (11.4–2): $S_{M1} = F_vS_1 = 3.299 \times 0.167 = 0.551$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

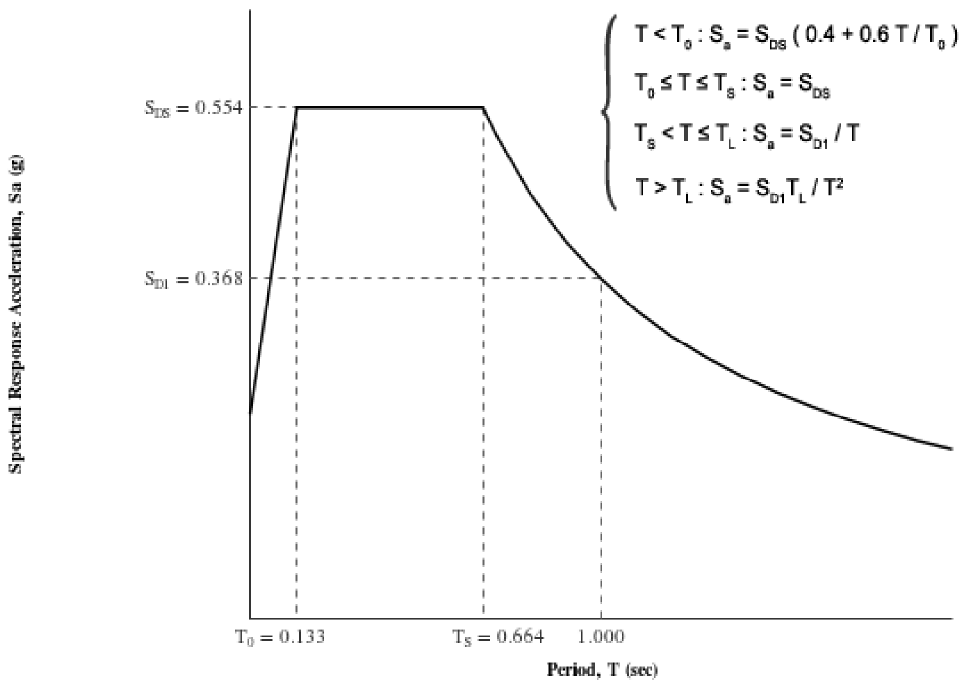
Equation (11.4–3): $S_{DS} = ⅔ S_{MS} = ⅔ \times 0.832 = 0.554$ g

Equation (11.4–4): $S_{D1} = ⅔ S_{M1} = ⅔ \times 0.551 = 0.368$ g

Section 11.4.5 — Design Response Spectrum

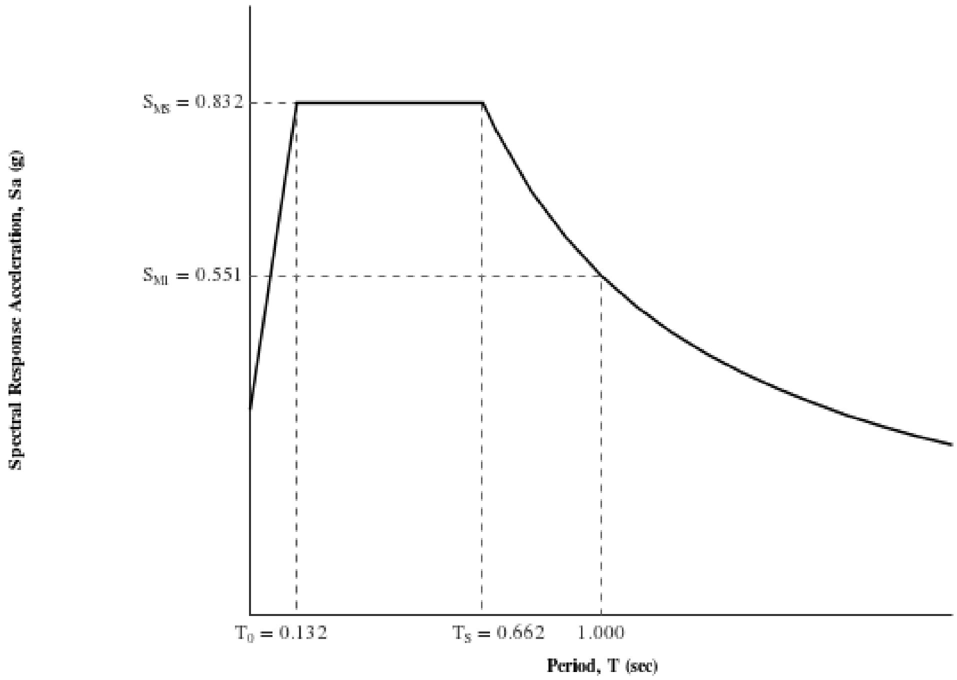
From Figure 22-12 [3] T_L = 12 seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.230

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.550 \times 0.230 = 0.357$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = E and PGA = 0.230 g, F_{PGA} = 1.550

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.867

From Figure 22-18 [6] C_{R1} = 0.833

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
S_{DS} < 0.167g	A	A	A
0.167g ≤ S_{DS} < 0.33g	B	B	C
0.33g ≤ S_{DS} < 0.50g	C	C	D
0.50g ≤ S_{DS}	D	D	D

For Risk Category = IV and S_{DS} = 0.554 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
S_{D1} < 0.067g	A	A	A
0.067g ≤ S_{D1} < 0.133g	B	B	C
0.133g ≤ S_{D1} < 0.20g	C	C	D
0.20g ≤ S_{D1}	D	D	D

For Risk Category = IV and S_{D1} = 0.368 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: https://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

ch2m	**Calculation**

Calculation No.:	CALC-687729-Soil Loss	**Revision No.:**	1
Project:	Old American Zinc Superfund Site - Facility Area Remedial Design	**Date:**	4/13/2018
Engineering Discipline:	Civil Engineering		
Title:	OAZ Facility Area Remedial Design - Universal Soil Loss Calculation		
Description:	The Universal Soil Loss Equation was used to calculate annual soil loss rates for the Consolidation Area to be constructed during the OAZ Facility Area Remedial Design before, during, and after construction. Calculations were performed for the greatest slope and slope length under present conditions, bare soil and fully vegetated conditions.		

Date Prepared	**Rev. No.**	**Preparer** Signature/Date	**Checker** Signature/Date	***For Professional Seal When Required***
4/13/2018	0	Tony Oxley 4/13/2018		

STC/SME Signature/Date	
LTR Signature/Date (if required)	

Comments:

Information Requiring Confirmation:

Calculation No.: CALC-687729-Soil Loss		Revision No.: 1
CH2M HILL	Project: Old American Zinc Superfund Site - Facility Area Remedial Design	Date: 4/13/2018

OBJECTIVE:

1 To calculate the Soil Loss rate for the Consolidation Area at the OAZ Facility Area under existing, bare, and fully vegetated conditions along the maximum slope - slope length.

METHODS:

The Universal Soil Loss Equation (USLE) is used to calculate annual soil loss rates for the slopes described in the objective statement. The equation is:

$A = RK(LS)CP$ (Ref 1)

where

A = Computed Soil Loss (tons/acre/year)

and

R = Rainfall Energy Factor for Fairmont City, Illinois
K = Soil Erodibility Factor
LS = Slope-Length Factor
C = Cropping Management Factor
P = Erosion Control Practice Factor

ASSUMPTIONS:

1

Assumed Values for the USLE Factors

USLE Factor	Value	Description of USLE Factor Value
R	225	The Rainfall Energy Coefficient for Fairmon City, IL. The site is located between the 200 and 250 rainfall energy coefficient contours, on the USDA average annual values of the rainfall erosion index map. (Ref 1)
K	0.05	The existing surface soil of the site consist of compacted and re-worked slag with less than 2% organics. (Ref 2&4)
	0.26	The final proposed top soil is based on locally available borrow soil is assumed to be loam with organic content greater than 5%. (Ref 2&4)
C	1	Bare ground assumed to have a coverage value of 1. (Ref 3)
	0.25	Current coverage factor of 0.25 is based on grassy vegetation with bare areas where slag is present.
	0.02	Vegetated surface to contain a coverage factor of 0.02. A coverage factor of 0.02 was assumed for final fully vegetated conditions. (Ref 2)
P*	1	Erosion control practice factor for landfill design is 1. (Ref 3)
LS	see table below	$LS = (0.065 + 0.0456S + 0.006541S^2)(\text{slope length} / 72.5)^{\text{slope exponent}}$ (Ref 1) where S = Slope (%)

slope	slope exponent
slope <1%	0.2
1% <= slope <= 3%	0.3
3% <= slope <= 5%	0.4
slope >5%	0.5

*Not shown in duration of calculation

2 Existing grades are generally less than 1 percent and proposed design final grades are3 percent; therefore the slope exponent will range from 0.2 to 0.3. See design drawings for existing conditions and proposed final design conditions.

ASSUMPTIONS:

3 Soil loss is calculated along the longest steepest section of the cover.

CALCULATIONS:

Calculated Annual Soil Loss and Length Slope Factor

Land Disturbing Activity	Rainfall Energy Factor R	Soil Erodibility Factor K	Cropping Management Factor C	Length - Slope Factor LS	Maximum Slope Length (Feet)	Slope (%)	Annual Soil Loss (ton/acre)
Existing Conditions	225	0.05	0.25	0.40	850	1	1.1
Bare Ground Existing	225	0.05	1.00	0.40	850	1	4.5
Bare Soil Final Grade	225	0.26	1.00	0.89	850	3	52.2
Restored- Completely Vegetated	225	0.26	0.02	0.89	850	3	1.0

CONCLUSION:

Once the Consolidation Area is in place, the restored-completely vegetated conditions yield soil loss is about 1.0 tons/acre/year which does not include the erosion protection netting proposed in the design. Specifications for topsoil are to contain > 5% organic material and seeding, mulching, and fertilization practices at the very least would be required for restoration. Also, mowing should be conducted at least two times per year. In general, soil loss quantity less than 2 tons/acre/year is acceptable. During construction, erosion control measures are required to manage the high volumes of soil loss. Refer to the design drawings for details for soil erosion control during construction and for final restoration.

REFERENCES:

1 Wischmeier, W H and D D Smith. "Predicting rainfall erosion losses-a guide to conservation planning." *Agriculture Handbook No. 537* . 1978.

2 Ontario Ministry of Agriculture, Food and Rural Affairs. *Universal Soil Loss Equation Fact Sheet* . n.d. 1 7 2014.

3 Qian, X and R M Koerner. *Geotechnical Aspects of Landfill Design and Construction* . 2002

4 USDA Custom Soil Report, Web Soil Suvey. http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Soil Map—St. Clair County, Illinois

Map Scale: 1:9,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 100, 200, 400, 600

Feet: 0, 400, 800, 1600, 2400

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Clair County, Illinois
Survey Area Data: Version 9, Sep 21, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 13, 2014—Jun 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
533	Urban land	230.1	75.2%
1071A	Darwin silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	4.3	1.4%
1248A	McFain silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	0.0	0.0%
2183A	Shaffton-Urban land complex, 0 to 2 percent slopes, occasionally flooded	60.7	19.9%
8183A	Shaffton clay loam, 0 to 2 percent slopes, occasionally flooded	6.0	2.0%
8304B	Landes very fine sandy loam, 2 to 5 percent slopes, occasionally flooded	4.6	1.5%
Totals for Area of Interest		**305.8**	**100.0%**

K Factor, Whole Soil—St. Clair County, Illinois

Map Scale: 1:9,190 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 400, 800, 1600, 2400

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Water Features

Streams and Canals

Transportation

Rails
Interstate Highways
US Routes
Major Roads
Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: St. Clair County, Illinois
Survey Area Data: Version 9, Sep 21, 2017

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 13, 2014—Jun 25, 2014

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
533	Urban land		230.1	75.2%
1071A	Darwin silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	.24	4.3	1.4%
1248A	McFain silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	.28	0.0	0.0%
2183A	Shaffton-Urban land complex, 0 to 2 percent slopes, occasionally flooded		60.7	19.9%
8183A	Shaffton clay loam, 0 to 2 percent slopes, occasionally flooded	.20	6.0	2.0%
8304B	Landes very fine sandy loam, 2 to 5 percent slopes, occasionally flooded	.32	4.6	1.5%
Totals for Area of Interest			**305.8**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Appendix B
Stormwater Design Caculations

TECHNICAL MEMORANDUM

Old American Zinc Facility Remediation Stormwater Design Calculations

PREPARED BY:	Megan Bender/MKE
REVIEWED BY:	Patrick Gervais/ATL
DATE:	May 14, 2018

Objectives

The following report and calculations demonstrate the design of the stormwater conveyance channels. The objectives of the stormwater calculations are as follows:

1. Estimate the stormwater runoff reaching each proposed stormwater conveyance channel during the 25-year and 100-year/24-hour rainfall events.
2. Determine the peak water surface elevations within each stormwater conveyance channel for the 25- and 100-year/24-hour rainfall events.
3. Size the channels to adequately convey runoff from the 25-year/24-hour storm event without overtopping and determine the extents of stormwater overtopping the conveyance channels during the 100-year/24-hour storm event.

Given

1. Natural Resources Conservation Service rainfall data for St. Clair County, Illinois. See Figure 1.

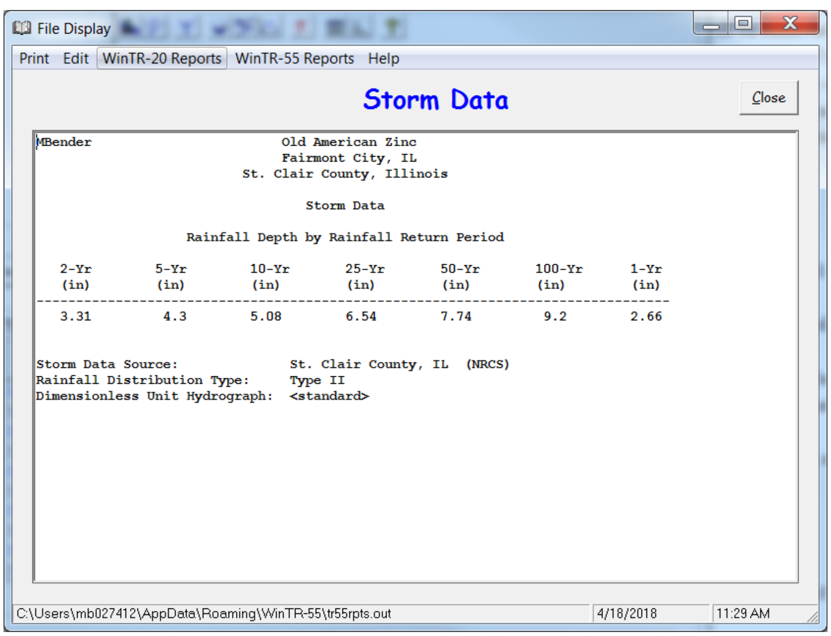


Figure 1. Natural Resources Conservation Service rainfall depth by return period.

Assumptions

1. The Hydrologic Soil Group for the site area is D. Both Hydrologic Soil Group D and B/D soils surround the project site, which is considered “urban land” according to the U.S. Department of Agriculture Web Soil Survey. Since urban land is not assigned a Hydrologic Soil Group, and D soils are present in the area of the project site, D soils were assumed for post-development land covers to be conservative.
2. A Curve Number of 84 (fair grass) was assumed for areas of proposed final cover.
3. A maximum sheet flow length of 100 feet was applied.
4. All channels were assumed to have a Manning’s Number of 0.04 (assume the swales will be fully vegetated), side slopes of 3H:1V, and a bottom width of 15 feet.

Procedure

The Soil Conservation Service Unit Hydrograph method implemented through the WIN TR-55 modeling program was used to estimate the runoff hydrographs produced by the 2-, 10-, 25-, 50-, and 100-year/24-hour storm events for ditches 1–8. The ditch drainage area map can be seen in Figure 2.

Figure 2. Drainage Area and Drainage Ditch Overview Map

The overland slopes, drainage areas, and channel slopes were all determined from the Overview Map in Figure 2. A summary of those values is found in Tables 1a and 1b.

Table 1a. Drainage Area Characteristics

	Slope	Area (ft^2)	L (ft)	Area (ac)	mi^2
DA_1	0.003846	1132370	700	25.9958	0.040618
DA_2	0.007143	691651	700	15.8782	0.02481
DA_3	0.007143	519363	960	11.923	0.01863
DA_4	0.00625	451039	800	15.0313	0.023486
DA_5	0.005	431160	500	9.89812	0.015466
DA_6	0.00625	775873	700	17.8117	0.027831
DA_7	0.033333	1007760	580	23.1351	0.036149
DA_8	0.033333	654759	600	10.3545	0.016179
DA_9	0.033333	186653	540	4.28499	0.006695
DA_10	0.033333	366094	560	8.40439	0.013132
DA_11	0.008333	87462	220	2.00785	0.003137

Table 1b. Drainage Ditch Characteristics

	Ditch_length ft	Slope, ft/ft
Ditch_1	1761	0.0020
Ditch_2	1041	0.0017
Ditch_3	723	0.0011
Ditch_4	1741	0.0025
Ditch_5	687	0.0023
Ditch_6	2458	0.0011
Ditch_7	2249	0.0033
Ditch_8	1130	0.0011

These values were entered into the WIN TR-55 program along with the curve numbers discussed above to determine the time of concentration (T_c) and ultimately the peak flow (Q, in cubic feet per second [cfs]). These numbers were double checked with hand calculations to ensure the values were in the right range. Ditches were modeled as reaches in WIN TR-55 to appropriately model all stormwater runoff reaching each ditch. The WIN TR-55 results are shown in Table 2, and the TR-55 hand calculations can be found in Appendix A.

Table 2. WIN TR-55 Peak Flows

	Q_2 cfs	Q_{10} cfs	Q_{25} cfs	Q_{50} cfs	Q_{100} cfs
Ditch_1	28.32	42.24	74.98	92.67	113.99
Ditch_2	41.15	63.08	114.11	141.6	176.09
Ditch_3	51.38	79.33	144.55	180.02	224.53
Ditch_4	33.75	50.32	89.11	110.14	135.62
Ditch_5	89.42	136.52	249.13	310.23	385.23
Ditch_6	101.45	156.68	291.58	365.62	457.94
Ditch_7	33.82	50.67	89.76	110.79	136.35
Ditch_8	2.54	3.99	5.33	6.6	8.14

These values were used to determine ditch depths that could capture the 25-year/24-hour flow. The velocity was kept below an erosive velocity of 5 feet per second as well. The depth was calculated using Manning's formula, where:

$$Q = \left(\frac{1.49}{n}\right) A * R^{2/3}\sqrt{S}$$

Where: Q = flow (cfs)

N = unitless Manning's roughness

A = area (ft^2)

R = hydraulic radius (ft)

S = slope (ft/ft)

See Table 3 for the depth of each ditch required to capture the 25-year/24-hour storm event with 1 foot of freeboard added. The calculations can be found in Appendix B.

Table 3. Ditch Depth, with Freeboard

Ditch_name	Depth, w/1' Freeboard:
Ditch_1	2.784
Ditch_2	3.354
Ditch_3	3.969
Ditch_4	2.845
Ditch_5	4.271
Ditch_6	5.247
Ditch_7	2.711
Ditch_8	1.500

The ditch depth, plus freeboard values from Table 3, were used as input for channel geometry in the United States Army Corps Hydraulic Engineering Center River Analysis System (HEC-RAS) to determine the extents of overtopping of the 100-year flood elevation. The results were similar between HEC-RAS

4.1.0 and WIN TR-55, only Ditch 6 had overtopping during the 100-year/24-hour storm event with the designed depth. For HEC-RAS profiles and output, see Appendix C.

Conclusion

Proposed ditches 1 through 4, and 7 should be constructed to a depth of 4.0 feet and Ditch 8 should be constructed to a depth of 1.5 feet to capture the 25-year/24-hour storm event with a minimum of 1-foot of freeboard. Ditches 5 and 6 should be constructed to a depth of 5.25 feet to capture the 25-year/24-hour event with 1-foot of freeboard. All proposed ditches would pass the 100-year/24-hour storm event without overtopping, except for Ditch 6, which overtops during that event even with the foot of freeboard. To capture the 100-year/24-hour flow in Ditch 6, the ditch would need to be constructed to a depth of at least 5.31 feet.

Appendix A

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)

Item		Unit	Segment ID: DA_1 upper	Segment ID:		Total
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		ft	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	in	3.12			
5.) Land Slope, s		ft/ft	0.0038			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.63	+	=	0.63

Shallow concentrated flow

Item		Unit	Segment ID: DA_2 lower	Segment ID:		Total
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	600			
9.) Watercourse slope, s		ft/ft	0.0038			
10.) Average velocity, v (figure 3-1)		ft/s	1.2			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr	0.14	+	=	0.14

Channel Flow

Item		Unit	Segment ID:	Segment ID:		Total
12.) Cross sectional flow area, a		ft^2				
13.) Wetted Perimeter, P_w		ft				
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft				
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s				
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr		+	=	0.00

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.77

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)

		Unit	Segment ID: DA_2 upper	Segment ID: (blank)		Total
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		ft	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	in	3.12			
5.) Land Slope, s		ft/ft	0.0071			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.49	+	=	0.49

Shallow concentrated flow

		Unit	Segment ID: DA_2 lower	Segment ID: (blank)		Total
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	600			
9.) Watercourse slope, s		ft/ft	0.0071			
10.) Average velocity, v (figure 3-1)		ft/s	1.3			
11.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0.13	+	=	0.13

Channel Flow

		Unit	Segment ID: (blank)	Segment ID: (blank)		Total
12.) Cross sectional flow area, a		ft^2				
13.) Wetted Perimeter, P_w		ft				
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft				
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s				
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr		+	=	0.00

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.62

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project:	Old American Zinc
Location:	Fairmont City, IL
Conditions:	Post Development
By:	Megan Bender/MKE
Date:	3/21/2018
Note:	

Sheet Flow (Applicable to T_c only)

			Segment ID	DA_3_upper			
1.) Surface Description (table 3-1)				Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)				0.35			
3.) Flow length, L (total L <= 300 ft)			ft	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71		in	3.12			
5.) Land Slope, s			ft/ft	0.0071			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$		Compute T_t	hr	0.49	+	=	0.49

Shallow concentrated flow

			Segment ID	DA_3 lower			
7.) Surface description (paved or unpaved)				Unpaved			
8.) Flow length, L			ft	860			
9.) Watercourse slope, s			ft/ft	0.0071			
10.) Average velocity, v (figure 3-1)			ft/s	1.3			
11.) $T_t = \frac{L}{3600\ v}$		Compute T_t	hr	0.18	+	=	0.18

Channel Flow

			Segment ID				
12.) Cross sectional flow area, a			ft^2	0			
13.) Wetted Perimeter, P_w			ft	0			
14.) Hydraulic Radius, $r = a/P_w$		Compute r	ft	0			
15.) Channel Slope, s			ft/ft				
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$		Compute v	ft/s	0			
18.) Flow Length, L			ft				
19.) $T_t = \frac{L}{3600\ v}$		Compute T_t	hr	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.68

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project:	Old American Zinc
Location:	Fairmont City, IL
Conditions:	Post Development
By:	Megan Bender/MKE
Date:	3/21/2018
Note:	

Sheet Flow (Applicable to T_c only)

		Units	Segment ID: DA_4 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		*ft*	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12				
5.) Land Slope, s		*ft/ft*	0.0063				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.52	+		=	0.52

Shallow concentrated flow

		Units	Segment ID: DA_4 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		*ft*	700				
9.) Watercourse slope, s		*ft/ft*	0.0063				
10.) Average velocity, v (figure 3-1)		*ft/s*	1.2				
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.16	+		=	0.16

Channel Flow

		Units	Segment ID				
12.) Cross sectional flow area, a		*ft*^{2}	0				
13.) Wetted Perimeter, P_w		*ft*	0				
14.) Hydraulic Radius, $r = a/P_w$	Compute r	*ft*	0				
15.) Channel Slope, s		*ft/ft*					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0				
18.) Flow Length, L		*ft*					
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.68

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project:	Old American Zinc
Location:	Fairmont City, IL
Conditions:	Post Development
By:	Megan Bender/MKE
Date:	3/21/2018
Note:	

Sheet Flow (Applicable to T_c only)

			Segment ID				
				DA_5 upper			
1.) Surface Description (table 3-1)				Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)				0.35			
3.) Flow length, L (total L <= 300 ft)			ft	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71		in	3.12			
5.) Land Slope, s			ft/ft	0.005			
6.) $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}\ s^{0.4}}$		Compute T_t	hr	0.57	+	=	0.57

Shallow concentrated flow

		Segment ID				
			DA_5 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	400			
9.) Watercourse slope, s		ft/ft	0.005			
10.) Average velocity, v (figure 3-1)		ft/s	1.2			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr	0.09	+	=	0.09

Channel Flow

		Segment ID				
12.) Cross sectional flow area, a		ft^2	0			
13.) Wetted Perimeter, P_w		ft	0			
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0			
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0			
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.66

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project:	Old American Zinc
Location:	Fairmont City, IL
Conditions:	Post Development
By:	Megan Bender/MKE
Date:	3/21/2018
Note:	

Sheet Flow (Applicable to T_c only)

		Units	Segment ID: DA_6 upper	Segment ID:	Total
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush		
2.) Manning's roughness coeff., n (table 3-1)			0.35		
3.) Flow length, L (total L <= 300 ft)		ft	100		
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	in	3.12		
5.) Land Slope, s		ft/ft	0.0063		
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.52	+	= 0.52

Shallow concentrated flow

		Units	Segment ID: DA_6 lower	Segment ID:	Total
7.) Surface description (paved or unpaved)			Unpaved		
8.) Flow length, L		ft	600		
9.) Watercourse slope, s		ft/ft	0.0063		
10.) Average velocity, v (figure 3-1)		ft/s	1.2		
11.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0.14	+	= 0.14

Channel Flow

		Units	Segment ID:	Segment ID:	Total
12.) Cross sectional flow area, a		ft^2	0		
13.) Wetted Perimeter, P_w		ft	0		
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0		
15.) Channel Slope, s		ft/ft			
16.) Manning's roughness coeff., n					
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0		
18.) Flow Length, L		ft			
19.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0	+	= 0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.66

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)

		Units	Segment ID: DA_7 upper				
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush				
2.) Manning's roughness coeff., n (table 3-1)			0.35				
3.) Flow length, L (total L <= 300 ft)		ft	100				
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	in	3.12				
5.) Land Slope, s		ft/ft	0.033				
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.27	+		=	0.27

Shallow concentrated flow

		Units	Segment ID: DA_7 lower				
7.) Surface description (paved or unpaved)			Unpaved				
8.) Flow length, L		ft	480				
9.) Watercourse slope, s		ft/ft	0.033				
10.) Average velocity, v (figure 3-1)		ft/s	2.8				
11.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0.05	+		=	0.05

Channel Flow

		Units	Segment ID				
12.) Cross sectional flow area, a		ft^2	0				
13.) Wetted Perimeter, P_w		ft	0				
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0				
15.) Channel Slope, s		ft/ft					
16.) Manning's roughness coeff., n							
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0				
18.) Flow Length, L		ft					
19.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0	+		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.31

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)

		Segment ID	DA_8 upper			
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		ft	100			
4.) Two-yr 24-hr rainfall, P_2 bulletin 71		in	3.12			
5.) Land Slope, s		ft/ft	0.033			
6.) $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.27	+	=	0.27

Shallow concentrated flow

		Segment ID	DA_8 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	500			
9.) Watercourse slope, s		ft/ft	0.033			
10.) Average velocity, v (figure 3-1)		ft/s	2.8			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr	0.05	+	=	0.05

Channel Flow

		Segment ID				
12.) Cross sectional flow area, a		ft^2	0			
13.) Wetted Perimeter, P_w		ft	0			
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0			
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0			
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	hr	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.32

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project:	Old American Zinc
Location:	Fairmont City, IL
Conditions:	Post Development
By:	Megan Bender/MKE
Date:	3/21/2018
Note:	

Sheet Flow (Applicable to T_c only)

		Unit	Segment ID: DA_9 upper			
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		*ft*	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	*in*	3.12			
5.) Land Slope, s		*ft/ft*	0.033			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	*hr*	0.27	+	=	0.27

Shallow concentrated flow

		Unit	Segment ID: DA_9 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		*ft*	440			
9.) Watercourse slope, s		*ft/ft*	0.033			
10.) Average velocity, v (figure 3-1)		*ft/s*	2.8			
11.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0.04	+	=	0.04

Channel Flow

		Unit	Segment ID			
12.) Cross sectional flow area, a		*ft²*	0			
13.) Wetted Perimeter, P_w		*ft*	0			
14.) Hydraulic Radius, $r = a/P_w$	Compute r	*ft*	0			
15.) Channel Slope, s		*ft/ft*				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	*ft/s*	0			
18.) Flow Length, L		*ft*				
19.) $T_t = \frac{L}{3600\ v}$	Compute T_t	*hr*	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) *hr* 0.31

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)		**Segment ID**	DA_10 upper			
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		ft	100			
4.) Two-yr 24-hr rainfall, P_2 bulletin 71		in	3.12			
5.) Land Slope, s		ft/ft	0.033			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.27 +		=	0.27

Shallow concentrated flow		**Segment ID**	DA_10 lower			
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	460			
9.) Watercourse slope, s		ft/ft	0.033			
10.) Average velocity, v (figure 3-1)		ft/s	2.8			
11.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0.05 +		=	0.05

Channel Flow		**Segment ID**				
12.) Cross sectional flow area, a		ft^2	0			
13.) Wetted Perimeter, P_w		ft	0			
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0			
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0			
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0 +		=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr **0.31**

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Time of Concentration & Travel Time Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development
By: Megan Bender/MKE
Date: 3/21/2018
Note:

Sheet Flow (Applicable to T_c only)

		Units	Segment ID: DA_11	Segment ID:		Total
1.) Surface Description (table 3-1)			Dense Grass/Light Underbrush			
2.) Manning's roughness coeff., n (table 3-1)			0.35			
3.) Flow length, L (total L <= 300 ft)		ft	100			
4.) Two-yr 24-hr rainfall, P_2	bulletin 71	in	3.12			
5.) Land Slope, s		ft/ft	0.0083			
6.) $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5}\,s^{0.4}}$	Compute T_t	hr	0.46	+	=	0.46

Shallow concentrated flow

		Units	Segment ID:	Segment ID:		Total
7.) Surface description (paved or unpaved)			Unpaved			
8.) Flow length, L		ft	120			
9.) Watercourse slope, s		ft/ft	0.0083			
10.) Average velocity, v (figure 3-1)		ft/s	2.8			
11.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0.01	+	=	0.01

Channel Flow

		Units	Segment ID:	Segment ID:		Total
12.) Cross sectional flow area, a		ft^2	0			
13.) Wetted Perimeter, P_w		ft	0			
14.) Hydraulic Radius, $r = a/P_w$	Compute r	ft	0			
15.) Channel Slope, s		ft/ft				
16.) Manning's roughness coeff., n						
17.) $v = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute v	ft/s	0			
18.) Flow Length, L		ft				
19.) $T_t = \frac{L}{3600\,v}$	Compute T_t	hr	0	+	=	0

20.) Watershed or subarea T_c or T_t (add T_t in steps 6, 11, 19) hr 0.47

(210-VI-TR-55, Second Ed., June 1986)

Note: Dense Grass ground cover, while reflecting existing conditions as specified in the County requirements, also reflects pre-developent conditions of "Meadow" as specified in the City's requirements.

Peak Flow Calculation Worksheet (TR-55 Methodology)

Project: Old American Zinc
Location: Fairmont City, IL
Conditions: Post Development — Curve number of 85 chosen - open space with C/D soils in an urban area
By: Megan Bender/MKE
Date: 3/21/2018

*note that anything below 0.10

	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_1	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.77	**400**	**26**	**1.0**	26.25	27.79
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.77	**410**	26	1.0	47.06	27.79
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.77	**410**	26	1.0	62.76	27.79
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.77	**410**	26	1.0	77.73	27.79
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.77	**410**	26	1.0	95.94	27.79
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_2	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.62	**460**	**15.88**	**1.0**	18.44	22.36
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.62	**450**	15.88	1.0	31.55	22.36
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.62	**450**	15.88	1.0	42.07	22.36
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.62	**450**	15.88	1.0	52.10	22.36
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.62	**450**	15.88	1.0	64.31	22.36
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_3	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.68	**440**	**11.92**	**1.0**	13.24	24.36
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.68	**430**	11.92	1.0	22.63	24.36
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.68	**430**	11.92	1.0	30.18	24.36
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.68	**430**	11.92	1.0	37.37	24.36
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.68	**430**	11.92	1.0	46.13	24.36
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_4	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.68	**440**	**15.03**	**1.0**	16.69	24.45
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.68	**430**	15.03	1.0	28.53	24.45
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.68	**430**	15.03	1.0	38.05	24.45
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.68	**430**	15.03	1.0	47.12	24.45
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.68	**430**	15.03	1.0	58.16	24.45
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_5	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.66	**435**	**9.9**	**1.0**	10.87	23.75
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.66	**425**	9.9	1.0	18.58	23.75
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.66	**425**	9.9	1.0	24.77	23.75
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.66	**425**	9.9	1.0	30.68	23.75
	100	**7.65**	84	1.90	0.38	5.76	0.05	0.66	**425**	9.9	1.0	37.87	23.75
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_6	2	**3.12**	**84**	1.90	0.38	1.62	0.12	0.66	**435**	**17.81**	**1.0**	19.56	23.61
	10	**4.51**	84	1.90	0.38	2.83	0.08	0.66	**425**	17.81	1.0	33.42	23.61
	25	**5.54**	84	1.90	0.38	3.77	0.07	0.66	**425**	17.81	1.0	44.56	23.61
	50	**6.5**	84	1.90	0.38	4.67	0.06	0.66	**425**	17.81	1.0	55.19	23.61

	100	7.65	84	1.90	0.38	5.76	0.05	0.66	425	17.81	1.0	68.12	23.61
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_7	2	3.12	84	1.90	0.38	1.62	0.12	0.31	660	23.14	1.0	38.55	11.31
	10	4.51	84	1.90	0.38	2.83	0.08	0.31	650	23.14	1.0	66.41	11.31
	25	5.54	84	1.90	0.38	3.77	0.07	0.31	650	23.14	1.0	88.55	11.31
	50	6.5	84	1.90	0.38	4.67	0.06	0.31	650	23.14	1.0	109.67	11.31
	100	7.65	84	1.90	0.38	5.76	0.05	0.31	650	23.14	1.0	135.36	11.31
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_8	2	3.12	84	1.90	0.38	1.62	0.12	0.32	660	10.35	1.0	17.24	11.38
	10	4.51	84	1.90	0.38	2.83	0.08	0.32	650	10.35	1.0	29.70	11.38
	25	5.54	84	1.90	0.38	3.77	0.07	0.32	650	10.35	1.0	39.61	11.38
	50	6.5	84	1.90	0.38	4.67	0.06	0.32	650	10.35	1.0	49.05	11.38
	100	7.65	84	1.90	0.38	5.76	0.05	0.32	650	10.35	1.0	60.55	11.38
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_9	2	3.12	84	1.90	0.38	1.62	0.12	0.31	660	4.28	1.0	7.13	11.17
	10	4.51	84	1.90	0.38	2.83	0.08	0.31	650	4.28	1.0	12.28	11.17
	25	5.54	84	1.90	0.38	3.77	0.07	0.31	650	4.28	1.0	16.38	11.17
	50	6.5	84	1.90	0.38	4.67	0.06	0.31	650	4.28	1.0	20.28	11.17
	100	7.65	84	1.90	0.38	5.76	0.05	0.31	650	4.28	1.0	25.04	11.17
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_10	2	3.12	84	1.90	0.38	1.62	0.12	0.31	660	8.4	1.0	13.99	11.24
	10	4.51	84	1.90	0.38	2.83	0.08	0.31	650	8.4	1.0	24.11	11.24
	25	5.54	84	1.90	0.38	3.77	0.07	0.31	650	8.4	1.0	32.14	11.24
	50	6.5	84	1.90	0.38	4.67	0.06	0.31	650	8.4	1.0	39.81	11.24
	100	7.65	84	1.90	0.38	5.76	0.05	0.31	650	8.4	1.0	49.14	11.24
	Frequency (yr)	Rainfall, P (in)	omposite C	S	I_a	Q (in)	I_a/P	t_c (hr)	q_u	Area (Ac)	F_p	Q_p (cfs)	L = 0.6Tc (min)
DA_11	2	3.12	84	1.90	0.38	1.62	0.12	0.47	530	2.01	1.0	2.69	17.10
	10	4.51	84	1.90	0.38	2.83	0.08	0.47	510	2.01	1.0	4.53	17.10
	25	5.54	84	1.90	0.38	3.77	0.07	0.47	510	2.01	1.0	6.04	17.10
	50	6.5	84	1.90	0.38	4.67	0.06	0.47	510	2.01	1.0	7.47	17.10
	100	7.65	84	1.90	0.38	5.76	0.05	0.47	510	2.01	1.0	9.23	17.10

Appendix B

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_2	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00167	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	2.354	Flow = flow through ditch using Manning's equation
Area:	51.93	Velocity = velocity of flow in the ditch
W.P.:	29.89	Top Width = top width water flowing in ditch
Flow (cfs):	114.15	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	2.20	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	29.12	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	1.78	Shear Stress = (62.4)*depth*slope
Froude Number:	0.29	
Conjugate Depth (ft.):	0.35	
Shear Stress (lb/ft^2):	0.24	

Q25	114.11	depth to ca	2.354
Q100:	176.09	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_3	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00111	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	2.97	Flow = flow through ditch using Manning's equation
Area:	70.98	Velocity = velocity of flow in the ditch
W.P.:	33.78	Top Width = top width water flowing in ditch
Flow (cfs):	144.59	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	2.04	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	32.81	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	2.16	Shear Stress = (62.4)*depth*slope
Froude Number:	0.24	
Conjugate Depth (ft.):	0.32	
Shear Stress (lb/ft^2):	0.21	

Q25	144.55	depth to ca	2.97
Q100:	224.53	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_4	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00250	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	1.85	Flow = flow through ditch using Manning's equation
Area:	37.89	Velocity = velocity of flow in the ditch
W.P.:	26.67	Top Width = top width water flowing in ditch
Flow (cfs):	89.18	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	2.35	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	26.07	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	1.45	Shear Stress = (62.4)*depth*slope
Froude Number:	0.34	
Conjugate Depth (ft.):	0.36	
Shear Stress (lb/ft^2):	0.29	

Q25	89.11	depth to ca	1.85
Q100:	135.62	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_5	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00227	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	3.27	Flow = flow through ditch using Manning's equation
Area:	81.16	Velocity = velocity of flow in the ditch
W.P.:	35.69	Top Width = top width water flowing in ditch
Flow (cfs):	249.26	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	3.07	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	34.63	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	2.34	Shear Stress = (62.4)*depth*slope
Froude Number:	0.35	
Conjugate Depth (ft.):	0.68	
Shear Stress (lb/ft^2):	0.46	

Q25	249.13	depth to ca	3.27
Q100:	385.23	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_6	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00111	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	4.247	Flow = flow through ditch using Manning's equation
Area:	117.82	Velocity = velocity of flow in the ditch
W.P.:	41.86	Top Width = top width water flowing in ditch
Flow (cfs):	291.62	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	2.48	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	40.48	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	2.91	Shear Stress = (62.4)*depth*slope
Froude Number:	0.26	
Conjugate Depth (ft.):	0.50	
Shear Stress (lb/ft^2):	0.29	

Q25	291.58	depth to ca	4.247
Q100:	457.94	with freeb	NO

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_7	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00333	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	1.71	Flow = flow through ditch using Manning's equation
Area:	34.45	Velocity = velocity of flow in the ditch
W.P.:	25.82	Top Width = top width water flowing in ditch
Flow (cfs):	89.78	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	2.61	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	25.27	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	1.36	Shear Stress = (62.4)*depth*slope
Froude Number:	0.39	
Conjugate Depth (ft.):	0.42	
Shear Stress (lb/ft^2):	0.36	

Q25	89.76	depth to ca	1.71
Q100:	136.35	with freeb	YES

Purpose: Compute the flow that occurs in a ditch with two differenent side slopes and a bottom width.
Assume Manning's formula.

Ditch for Drainage Area	Ditch_8	z1 = ditch side slope 1
		z2 = ditch side slope 2
Ideal Conditions		b = bottom width
z1:	3	Slope = slope along flow line of ditch
z2:	3	Manning's n = Manning's roughness factor
b:	15	Depth = depth of flow in the ditch
Slope (ft./ft.):	0.00110	Area = cross-sectional area of flow in ditch
Manning's n:	0.040	W.P. = wetted perimeter of ditch
Depth (ft.):	0.5	Flow = flow through ditch using Manning's equation
Area:	8.25	Velocity = velocity of flow in the ditch
W.P.:	18.16	Top Width = top width water flowing in ditch
Flow (cfs):	6.02	Hydraulic Depth = defined as Area/Top width
Velocity (ft./sec.):	0.73	Froude Number = defined as Vel/(sqrt(g*Hydraulic Depth))
Top Width (ft.):	18.00	Conjugate Depth = (Depth/2)*(sqrt(1+8*F#)-1)
Hydraulic Depth (ft.):	0.46	Shear Stress = (62.4)*depth*slope
Froude Number:	0.19	
Conjugate Depth (ft.):	0.03	
Shear Stress (lb/ft^2):	0.03	

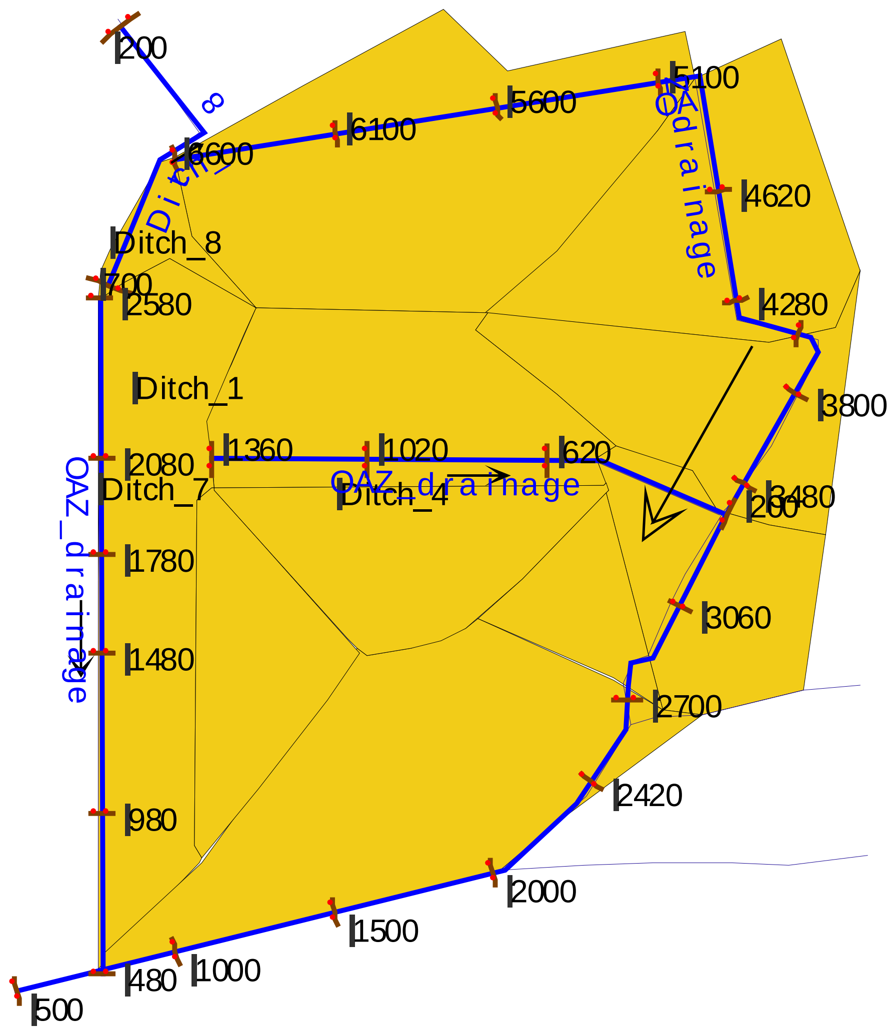
Q25	5.33	depth to ca	0.5
Q100:	8.14	with freeb	YES

Appendix C

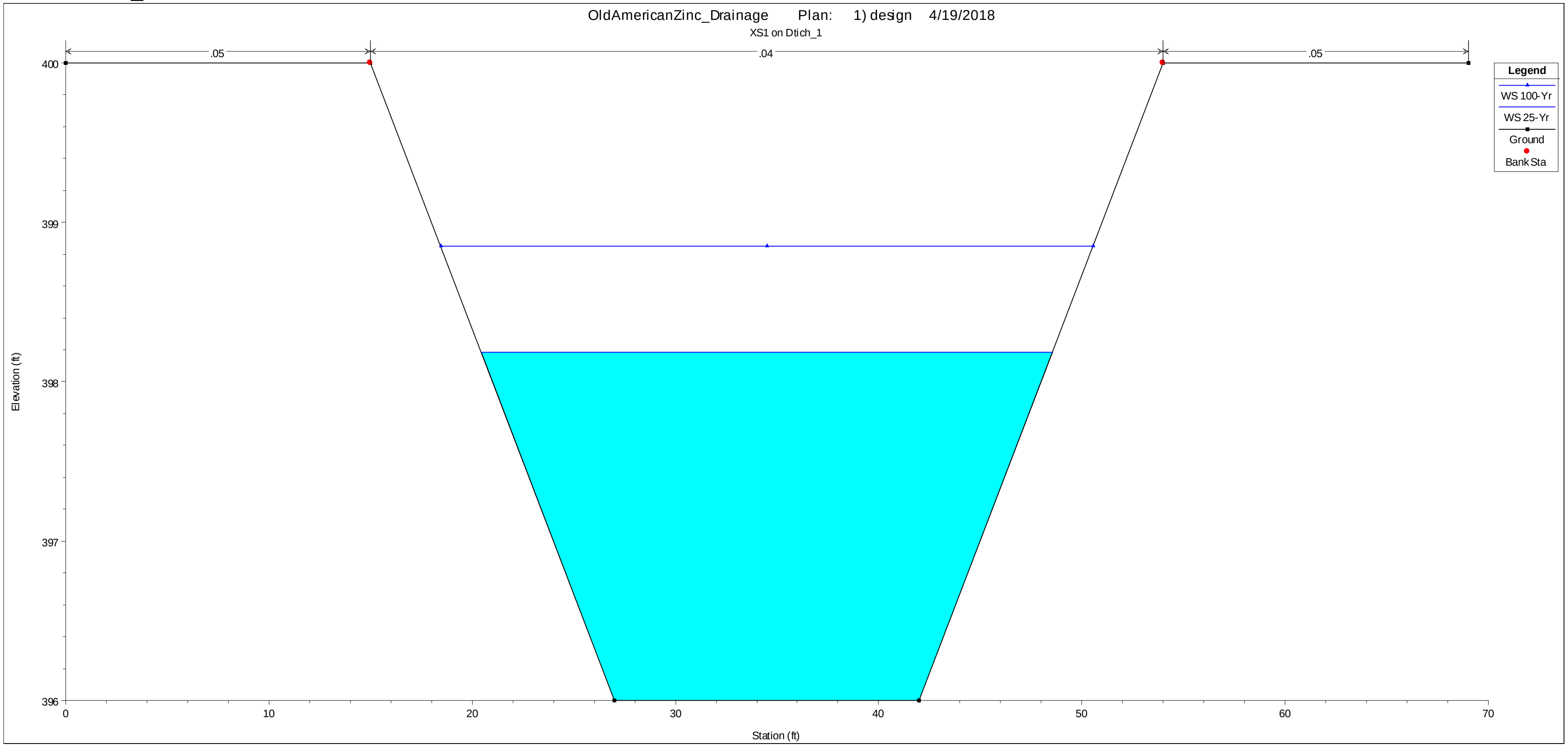
Reach	River Sta	Profile	Q Total (cfs)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Chl Dpth (ft)	Vel Chnl (ft/s)
Ditch_1	6600	25-Yr	74.98	36.39	25.72	0.31	1.79	2.06
Ditch_1	6600	100-Yr	113.99	48.83	28.48	0.31	2.25	2.33
Ditch_1	6100	25-Yr	74.98	36.33	25.71	0.31	1.78	2.06
Ditch_1	6100	100-Yr	113.99	49.12	28.54	0.31	2.26	2.32
Ditch_1	5600	25-Yr	74.98	37.22	25.92	0.3	1.82	2.01
Ditch_1	5600	100-Yr	113.99	52.81	29.3	0.28	2.38	2.16
Ditch_1	5100	25-Yr	74.98	47.1	28.11	0.22	2.19	1.59
Ditch_1	5100	100-Yr	113.99	67.1	32.1	0.21	2.85	1.7
Ditch_2	4620	25-Yr	114.11	54.46	29.64	0.27	2.44	2.1
Ditch_2	4620	100-Yr	179.06	77.18	33.93	0.27	3.15	2.32
Ditch_2	4280	25-Yr	114.11	57.98	30.34	0.25	2.56	1.97
Ditch_2	4280	100-Yr	179.06	82.5	34.86	0.25	3.31	2.17
Ditch_2	4040	25-Yr	114.11	62.29	31.18	0.23	2.7	1.83
Ditch_2	4040	100-Yr	179.06	88.16	35.82	0.23	3.47	2.03
Ditch_3	3800	25-Yr	144.55	67.9	32.25	0.26	2.87	2.13
Ditch_3	3800	100-Yr	224.53	95	36.95	0.26	3.66	2.36
Ditch_3	3480	25-Yr	144.55	65.2	31.74	0.27	2.79	2.22
Ditch_3	3480	100-Yr	224.53	93.33	36.67	0.27	3.61	2.41
Ditch_3	3060	25-Yr	144.55	57.09	30.17	0.32	2.53	2.53
Ditch_3	3060	100-Yr	224.53	89.9	36.11	0.28	3.52	2.5
Ditch_5	2700	25-Yr	249.13	108.11	39.02	0.24	4	2.3
Ditch_5	2700	100-Yr	385.23	152.23	45.3	0.24	5.05	2.53
Ditch_6	2420	25-Yr	291.58	117.96	40.5	0.26	4.25	2.47
Ditch_6	2420	100-Yr	457.94	164.87	76.5	0.26	5.3	2.8
Ditch_6	2000	25-Yr	291.58	118.02	40.51	0.26	4.25	2.47
Ditch_6	2000	100-Yr	457.94	165.01	76.5	0.26	5.3	2.8
Ditch_6	1500	25-Yr	291.58	118.24	40.55	0.25	4.26	2.47
Ditch_6	1500	100-Yr	457.94	165.5	76.5	0.26	5.3	2.79
Ditch_6	1000	25-Yr	291.58	118.17	40.53	0.25	4.26	2.47
Ditch_6	1000	100-Yr	457.94	165.29	76.5	0.26	5.3	2.79

Reach	River Sta	Profile	Q Total (cfs)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Max Chl Dpth (ft)	Vel Chnl (ft/s)
Ditch_6	500	25-Yr	291.58	118.43	40.58	0.25	4.26	2.46
Ditch_6	500	100-Yr	457.94	165.87	76.5	0.26	5.31	2.79
Ditch_7	2580	25-Yr	89.76	34.47	25.27	0.39	1.71	2.6
Ditch_7	2580	100-Yr	136.35	46.07	27.89	0.41	2.15	2.96
Ditch_7	2080	25-Yr	89.76	34.57	25.3	0.39	1.72	2.6
Ditch_7	2080	100-Yr	136.35	46.21	27.93	0.4	2.16	2.95
Ditch_7	1780	25-Yr	89.76	34.45	25.27	0.39	1.71	2.61
Ditch_7	1780	100-Yr	136.35	46.19	27.92	0.4	2.15	2.95
Ditch_7	1480	25-Yr	89.76	34.56	25.3	0.39	1.72	2.6
Ditch_7	1480	100-Yr	136.35	46.22	27.93	0.4	2.16	2.95
Ditch_7	980	25-Yr	89.76	34.45	25.26	0.39	1.71	2.61
Ditch_7	980	100-Yr	136.35	46.26	27.93	0.4	2.16	2.95
Ditch_7	480	25-Yr	89.76	34.63	25.31	0.39	1.72	2.59
Ditch_7	480	100-Yr	136.35	46.34	27.95	0.4	2.16	2.94
Ditch_4	1360	25-Yr	89.11	37.94	26.08	0.34	1.85	2.35
Ditch_4	1360	100-Yr	135.62	50.93	28.91	0.35	2.32	2.66
Ditch_4	1020	25-Yr	89.11	37.93	26.08	0.34	1.85	2.35
Ditch_4	1020	100-Yr	135.62	50.92	28.91	0.35	2.32	2.66
Ditch_4	620	25-Yr	89.11	37.95	26.08	0.34	1.85	2.35
Ditch_4	620	100-Yr	135.62	50.93	28.91	0.35	2.32	2.66
Ditch_4	200	25-Yr	89.11	37.93	26.08	0.34	1.85	2.35
Ditch_4	200	100-Yr	135.62	50.92	28.91	0.35	2.32	2.66
Ditch_8	700	25-Yr	5.33	7.69	17.81	0.19	0.47	0.69
Ditch_8	700	100-Yr	8.14	9.99	18.57	0.2	0.6	0.81
Ditch_8	200	25-Yr	5.33	7.64	17.8	0.19	0.47	0.7
Ditch_8	200	100-Yr	8.14	10.03	18.58	0.19	0.6	0.81

HEC-RAS Geometry Overview

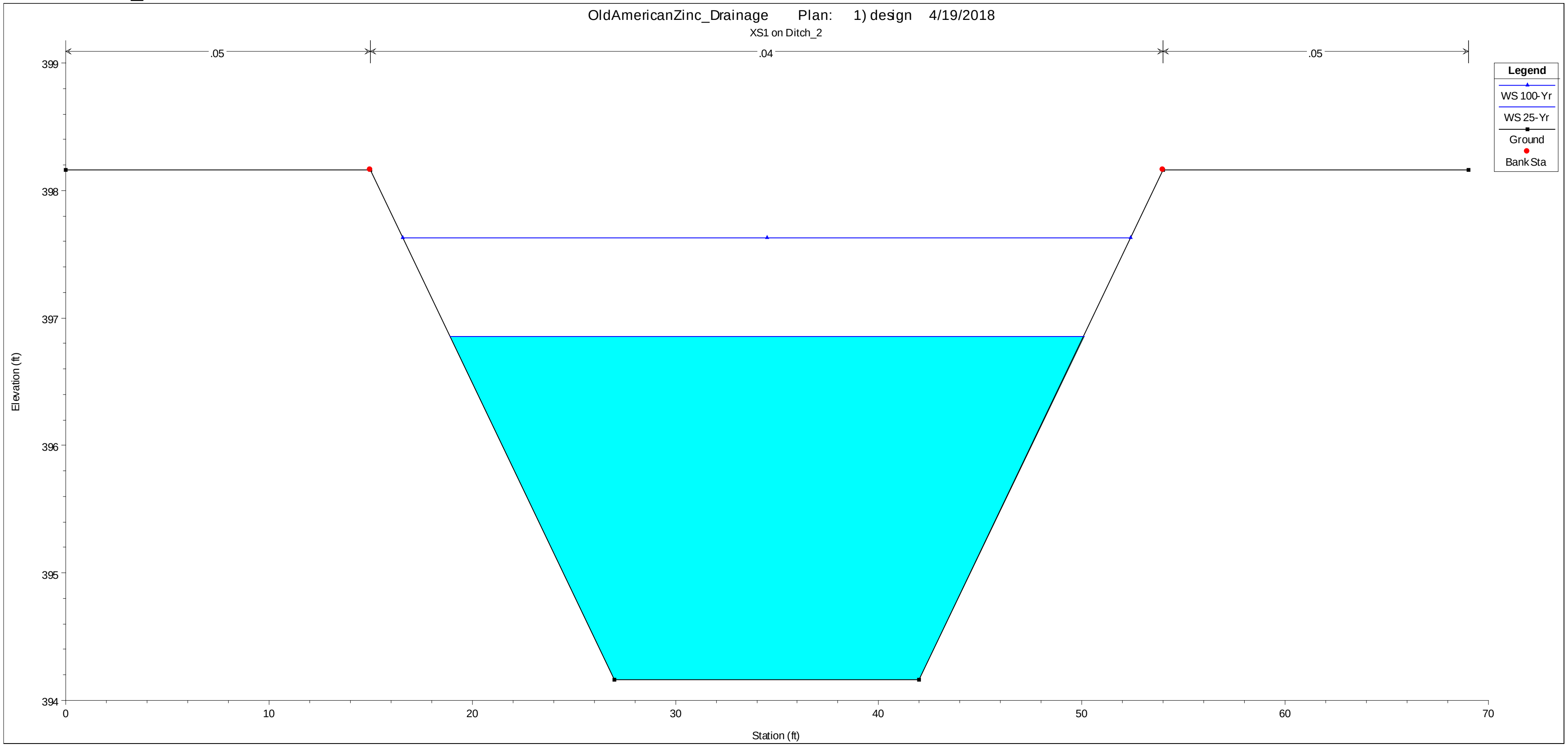


Profile Ditch_1



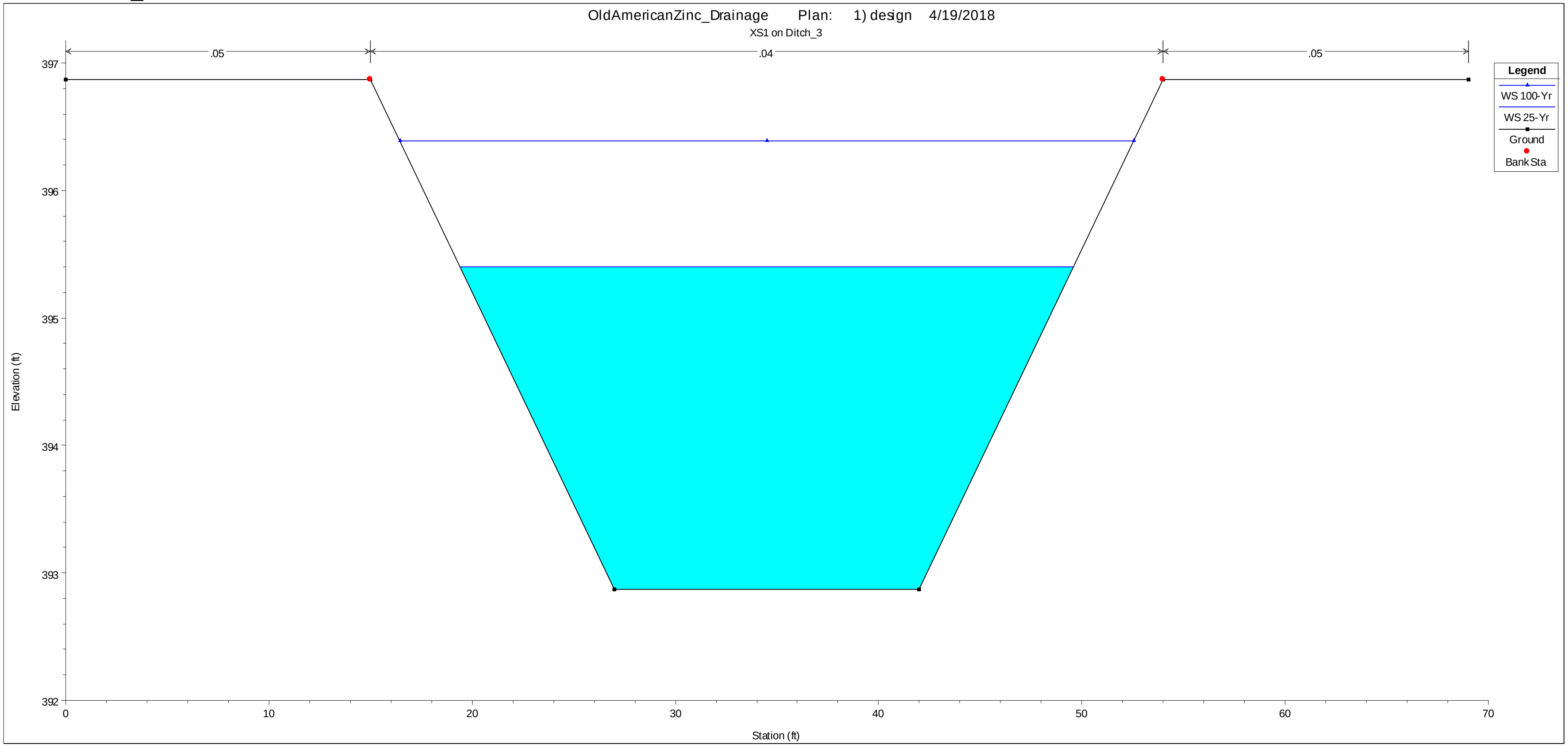
Note: elevations on y-axis are not real

Profile Ditch_2



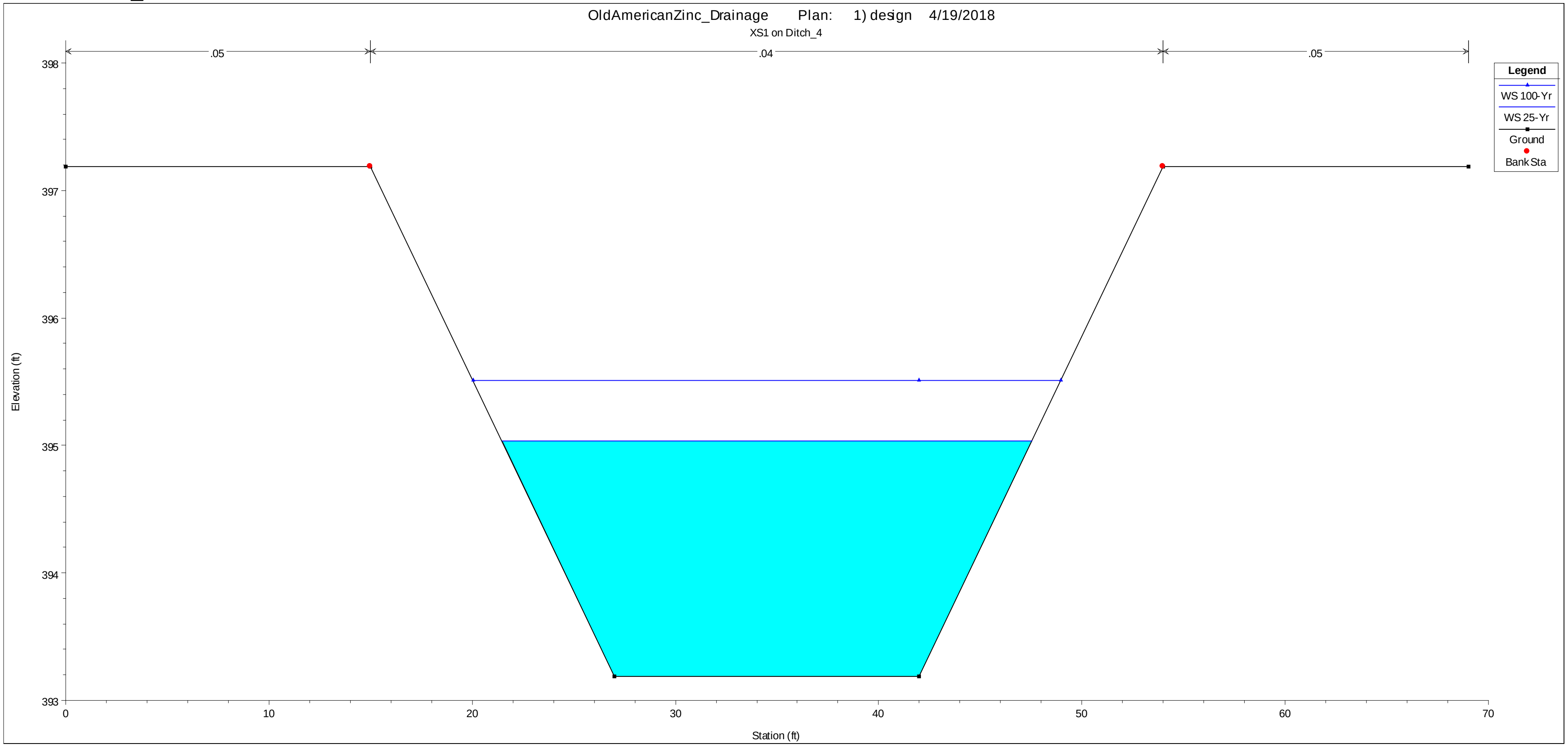
Note: elevations on y-axis are not real

Profile Ditch_3



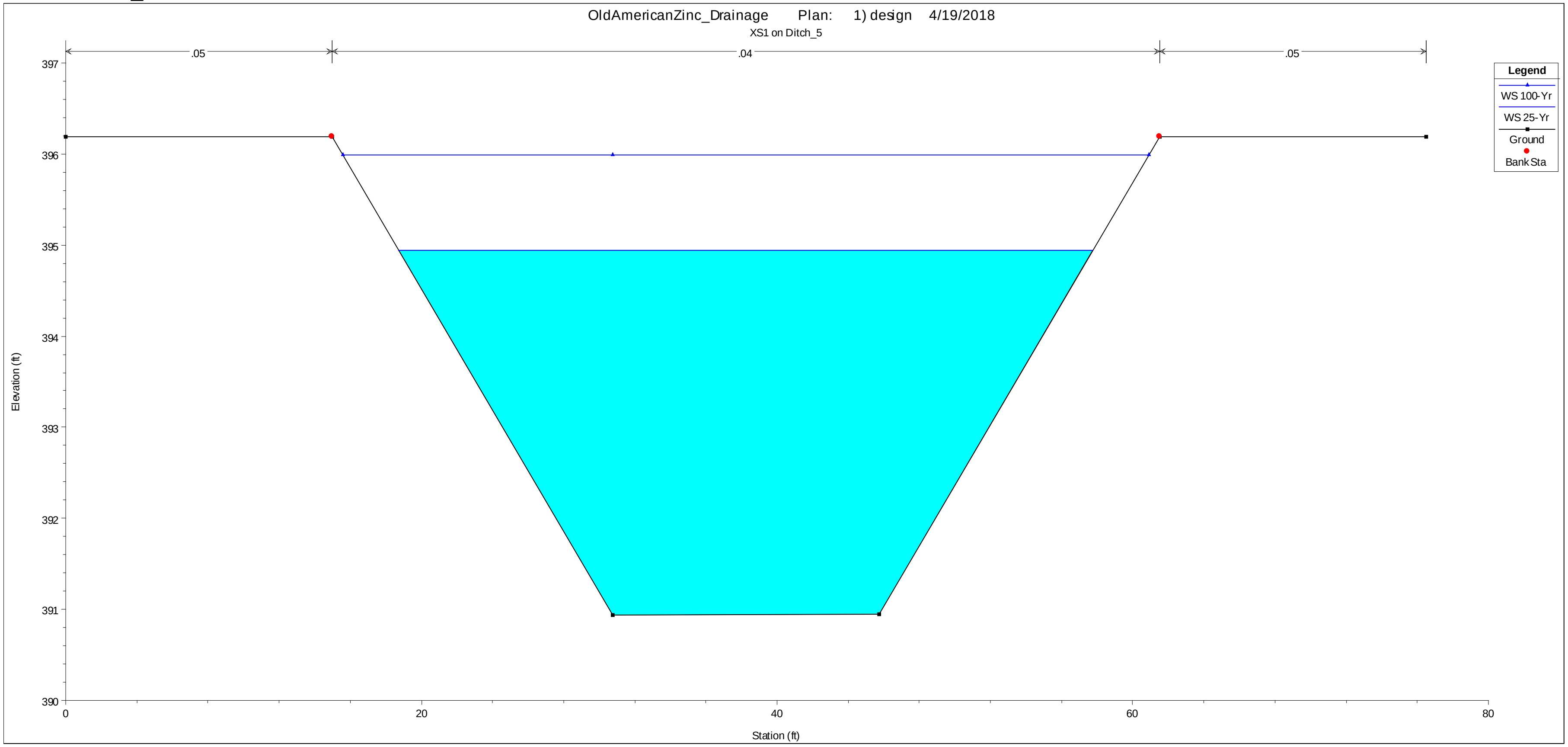
Note: elevations on y-axis are not real

Profile Ditch_4



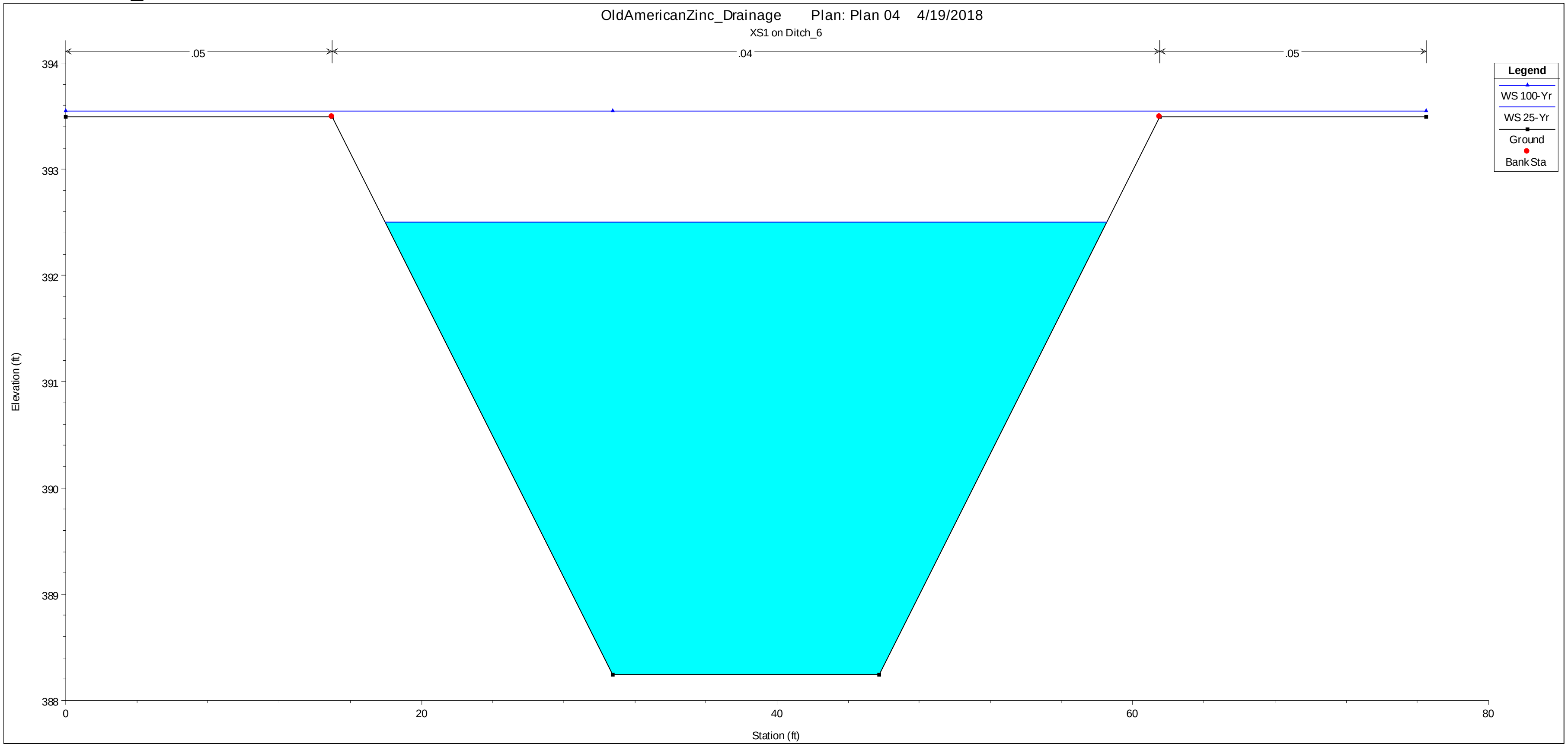
Note: elevations on y-axis are not real

Profile Ditch_5



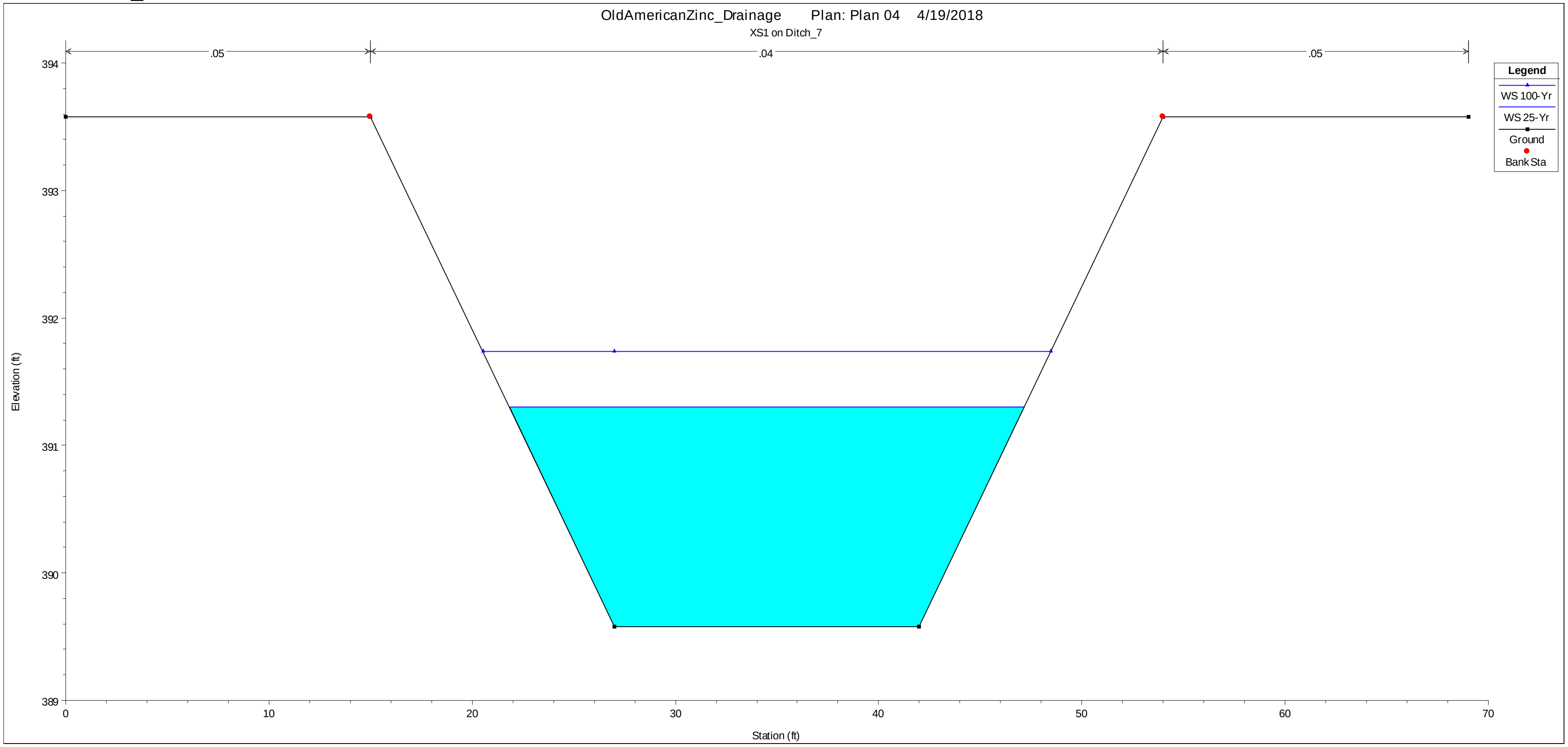
Note: elevations on y-axis are not real

Profile Ditch_6



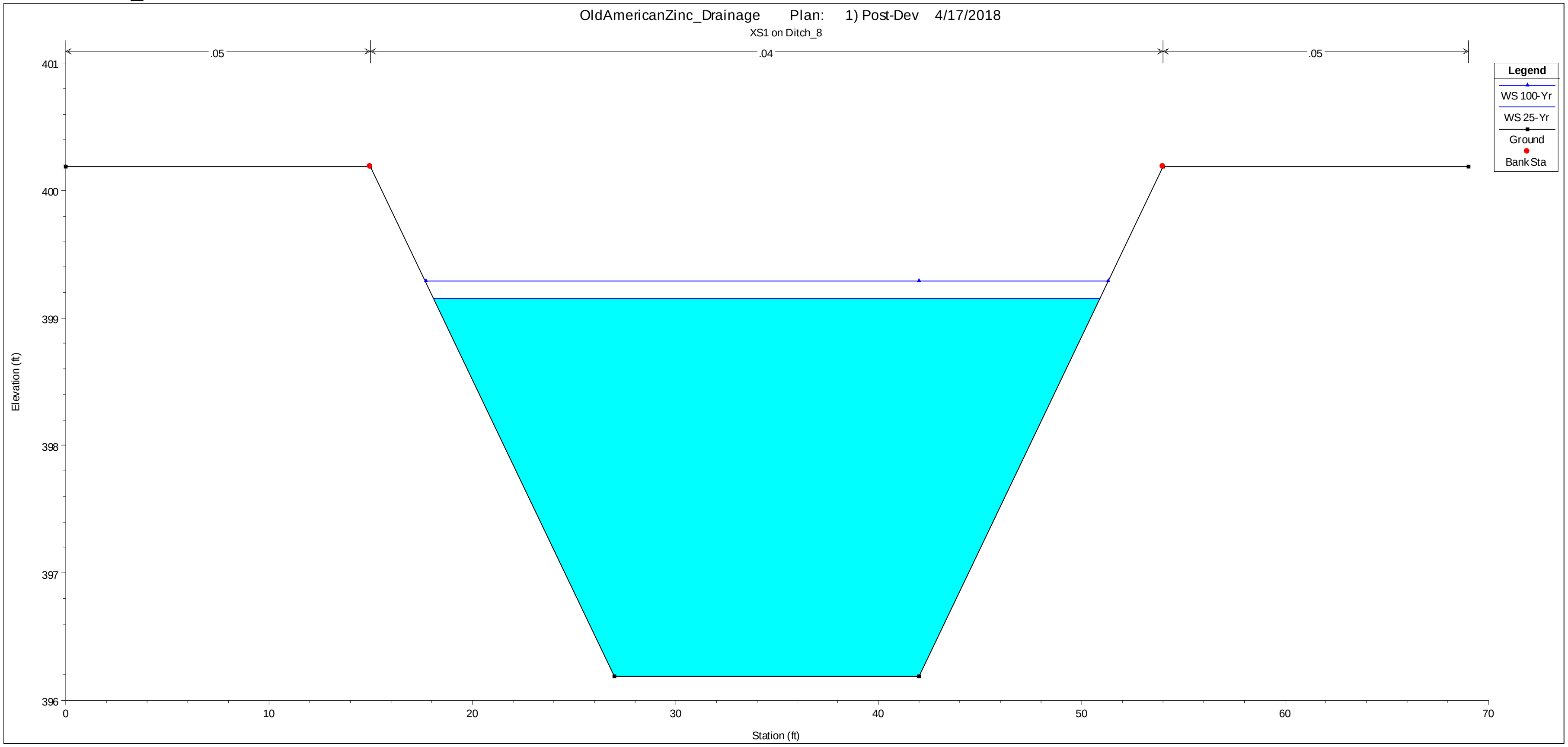
Note: elevations on y-axis are not real

Profile Ditch_7



Note: elevations on y-axis are not real

Profile Ditch_8



Note: elevations on y-axis are not real

Appendix C
Facility Area Remedial Design Specifications

Prefinal Design for

U.S. Environmental Protection Agency
Fairmount City
St. Clair County, Illinois

Old American Zinc Plant Superfund Site
Facility Design

Specifications

Project Number 677664

May 2018

TABLE OF CONTENTS

END OF SECTION

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUBMITTALS

A. Action Submittals:

1. Operations Plan:
   a. Submit an Operations Plan for approval that includes, but it not limited to:
      1) Description and list of operations that will be performed in connection with work to be performed at the site.
      2) Description of equipment and crew that will be used.
      3) Sequence of work.
      4) Means and methods for construction.
      5) Sources of imported materials.
      6) Excavation Plan, Detailing:
         a) Utility Clearance.
         b) Methods and sequencing of excavation.
         c) Numbers, types, and sizes of equipment proposed to perform excavations.
         d) Anticipated difficulties and proposed resolutions.

1.02 WORK COVERED BY CONTRACT DOCUMENTS

A. Facility Area Remedial Action:

1. Mobilization.
2. Surveying to document existing site conditions.
3. Installation of new erosion/runoff control measures.
4. General clearing required to construct the site improvements as shown in the Drawings.
5. Installation of Contractor staging areas.
6. Clear and Grub site.
7. Excavate surficial slag from the Consolidation Area and clay stockpile areas as shown in the Drawings.
8. Excavate clay from the Consolidation Area.
   a. Stockpile clay for the Consolidation Area in the eastern portion of the site as shown in the Drawings.
   b. Stockpile clay for general site fill in the northern portion of the site as shown in the Drawings.

9. Place stockpiled slag from northwestern portion of site into the Consolidation Area.
10. Excavate surficial slag from the remainder of the Facility Area site and place into Consolidation Area.
11. Place two-foot thick clay cover over Consolidation Area.
12. Fill site to design grades using stockpiled clay for general site fill.
13. Place one-foot of topsoil over the site, including the Consolidation Area.
14. Install seed, mulch, and erosion control for the entire site.
15. Surveying to document remediated site conditions.
16. Demobilization.

1.03 WORK NOT COVERED BY CONTRACT DOCUMENTS

A. Remedial work performed at adjacent residential properties.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on form approved by Owner's Representative .
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 CASH ALLOWANCES

A. Consult with Engineer in selection of products or services. Obtain proposals from Suppliers and installers, and offer recommendations.

B. Cash allowances will be administered in accordance with Paragraph 13.02 of General Conditions.

C. Submit, with application for payment, invoice showing date of purchase, from whom the purchase was made, the date of delivery of the product or service, and the price, including delivery to the Site and applicable taxes.

1.03 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. Reflect specified cash and contingency allowances and alternates, as applicable.

2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
   a. Mobilization includes, at minimum, items identified in Section 01 50 00, Temporary Facilities and Controls.
   b. Include item(s) for monthly progress schedule update and maintenance of Engineer's trailer.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

G. Submit Schedule of Values on a CD in a spreadsheet format compatible with latest version of MS Excel.

1.04 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.

B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.05 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form suitable to Engineer.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.06 MEASUREMENT—GENERAL

A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.

B. Whenever pay quantities of material are determined by weight, weigh material on scales furnished by Contractor and certified accurate by state agency responsible. Obtain weight or load slip from weigher and deliver to Owner's representative at point of delivery of material.

C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.

D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.

E. Haul materials that are specified for measurement by the cubic yard measured in the vehicle in transport vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Load vehicles to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.

F. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.

G. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

H. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.07 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install the following items.

1.08 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.

3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.09 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

1.10 PARTIAL PAYMENT FOR UNDELIVERED, PROJECT-SPECIFIC MANUFACTURED OR FABRICATED EQUIPMENT

A. Notwithstanding above provisions, partial payments for undelivered (not yet delivered to Site or not stored in the vicinity of Site) products specifically manufactured for this Project, excluding off the shelf or catalog items, will be made for products listed below when all following conditions exist:

1. Partial payment request is supported by written acknowledgment from Suppliers that invoice requirements have been met.
2. Equipment is adequately insured, maintained, stored, and protected by appropriate security measures.
3. Each equipment item is clearly marked and segregated from other items to permit inventory and accountability.
4. Authorization has been provided for access to storage Site for Engineer and Owner.
5. Equipment meets applicable Specifications of these Contract Documents.

B. Payment of 15 percent of manufacturer’s quoted price for undelivered, Project-specific manufactured equipment will be made following Shop Drawing approval. Thereafter, monthly payments will be made based on progress of fabrication as determined by Engineer, but in no case will total of payments prior to delivery exceed 75 percent of manufacturer’s quoted price.

C. Failure of Contractor to continue compliance with above requirements shall give cause for Owner to withhold payments made for such equipment from future partial payments.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or civil engineer.
2. Statement of Qualification (SOQ) for professional photographer and videographer.
3. Photographs:
   a. Digital Images: Submit one copy of a DVD disc containing images within 5 days of being taken. Each image is to have a minimum file size of 1.4 Mb (1,400 Kb) so viewed resolution is high quality. The production of larger file sizes with higher resolution is encouraged.
4. Video Recordings: Submit one copy, including updated copy of project video log, within 5 days of being taken.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during the Work.

1.04 PROJECT MILESTONES

A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.

1.05 FACILITY OPERATIONS

A. Operations on site are no longer active.

1.06 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

B. Documentation:

1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs and Article Audio-Video Recordings.
2. Upon receipt, Engineer will review, sign, and return one record copy of documentation to Contractor to be kept on file in field office.
3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.07 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Photography shall be by a professional commercial photographer, experienced in shooting exterior construction photos, in daylight and nighttime conditions, and in good and inclement weather.
3. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
4. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 48 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures both inside and outside the Site.
3. Format: Digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

C. Construction Progress Photos:

1. Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.
2. Weekly: Take 48 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.
3. Monthly: Take 50 photographs using digital, minimum resolution of 1832 by 3264 pixels and 24-bit, millions of color.

D. Documentation:

1. Digital Images:
   a. Electronic image shall have date taken embedded into image.
   b. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
   c. Label each disk with Project and Owner’s name, and month and year images were produced.

1.08 AUDIO-VIDEO RECORDINGS

A. Prior to beginning the Work on Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, video-graph Site and property adjacent to Site.

B. In the case of preconstruction recording, no work shall begin in the area prior to Engineer’s review and approval of content and quality of video for that area.

C. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.

D. Video recording shall be by a professional commercial videographer, experienced in shooting exterior construction videos, in both good and inclement weather.

E. Video Format and Quality:

1. DVD format, with sound.
2. Video:
   a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.
   b. Electronically, and accurately display the month, day, year, and time of day of the recording.
3. Audio:
   a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
   b. Indicate date, project name, and a brief description of the location of recording, including:
      1) Facility name.
      2) Street names or easements.
      3) Addresses of private property.
      4) Direction of coverage, including engineering stationing, if applicable.

F. Documentation:

1. DVD Label:
   a. DVD number (numbered sequentially, beginning with 001).
   b. Project name.
   c. Name of street(s) or easement(s) included.
   d. Applicable location by engineering stationing.
   e. Date and time of coverage.
2. Project Video Log: Maintain an ongoing log that incorporates above noted label information for DVDs on Project.

1.09 REFERENCE POINTS AND SURVEYS

A. Contractor’s Responsibilities:

1. Establish bench marks convenient to Work and at least every 500 feet on pipelines and roads.
2. Establish horizontal reference points or coordinate system with bench marks and reference points as necessary to lay out Work.
3. Provide additional survey and layout required to layout the Work.
4. Notify Engineer at least 3 working days in advance of time when grade and line to be provided by Owner will be needed.

5. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
6. Retain professional land surveyor or civil engineer registered in state of Illinois who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
7. Maintain complete accurate log of survey work as it progresses as a Record Document.
8. On request of Engineer, submit documentation.
9. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
    a. Establish control points, lines, and easement boundaries.
    b. Check layout, survey, and measurement work performed by others.
    c. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

END OF SECTION

SECTION 01 31 19
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Contractor shall schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor’s safety plan and representative.
9. Private utilities on site.

B. Attendees will include:

1. Owner’s representatives.
2. Contractor’s office representative.
3. Contractor’s resident superintendent.
4. Contractor’s quality control representative.
5. Subcontractors’ representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer’s representatives.
7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01 32 00, Construction Progress Documentation.

1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 QUALITY CONTROL MEETINGS

A. Scheduled by Engineer on regular basis and as necessary to review test and inspection reports, and other matters relating to quality control of the Work and work of other Contractors.

B. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and Suppliers, as necessary.
4. Engineer's representatives.

1.06 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 4 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.07 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Detailed Progress Schedule:
    a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
    b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
    a. Contractor’s certification that Progress Schedule submission is actual schedule being used for execution of the Work.
    b. Electronic file compatible with latest version of Project Planner (P6) by Primavera Systems, Inc., unless otherwise approved by Engineer.
    c. Progress Schedule: 4 legible copies.
    d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
    e. Progress Quantity Chart(s).
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Earthwork.
7. Specified Work sequences and construction constraints.

8. Contract Milestone and Completion Dates.
9. Owner-furnished products delivery dates or ranges of dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Format: In accordance with Article Progress Schedule—Critical Path Network.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—CRITICAL PATH NETWORK

A. General: Comprehensive computer-generated schedule using CPM, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.

B. Contents:

1. Schedule shall begin with the date of Notice to Proceed and conclude with the date of Final Completion.
2. Identify Work calendar basis using days as a unit of measure.
3. Show complete interdependence and sequence of construction and Project-related activities reasonably required to complete the Work.
4. Identify the Work of separate stages and other logically grouped activities, and clearly identify critical path of activities.
5. Reflect sequences of the Work, restraints, delivery windows, review times, Contract Times and Project Milestones set forth in the Agreement and Section 01 31 13, Project Coordination.
6. Include as applicable, at a minimum:
    a. Obtaining permits, submittals for early product procurement, and long lead time items.
    b. Mobilization and other preliminary activities.
    c. Initial Site work.
    d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s) Subcontract Work.
    e. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
    f. Sitework.
    g. Project closeout and cleanup.
    h. Demobilization.
7. No activity duration, exclusive of those for Submittals review and product fabrication/delivery, shall be less than 1 day nor more than 14 days, unless otherwise approved.
8. Activity duration for Submittal review shall not be less than review time specified unless clearly identified and prior written acceptance has been obtained from Engineer.

C. Network Graphical Display:

1. Plot or print on paper not greater than 30 inches by 42 inches or smaller than 22 inches by 34 inches, unless otherwise approved.
2. Title Block: Show name of Project, Owner, date submitted, revision or update number, and the name of the scheduler. Updated schedules shall indicate data date.
3. Identify horizontally across top of schedule the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Indicate the critical path.
6. Show, at a minimum, the controlling relationships between activities.

7. Plot activities on a time-scaled basis, with the length of each activity proportional to the current estimate of the duration.
8. Plot activities on an early start basis unless otherwise requested by Engineer.
9. Provide a legend to describe standard and special symbols used.

D. Schedule Report:

1. On 8-1/2-inch by 11-inch white paper, unless otherwise approved.
2. List information for each activity in tabular format, including at a minimum:
   a. Activity Identification Number.
   b. Activity Description.
   c. Original Duration.
   d. Remaining Duration.
   e. Early Start Date (Actual start on Updated Progress Schedules).
   f. Early Finish Date (Actual finish on Updated Progress Schedules).
   g. Late Start Date.
   h. Late Finish Date.
   i. Total Float.
3. Sort reports, in ascending order: Activity number sequence with predecessor and successor activity.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed sub-schedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

C. If an activity is not completed by its latest scheduled completion date and this failure is anticipated to extend Contract Times (or Milestones), submit, within 7 days of such failure, a written statement as to how nonperformance will be corrected to return Project to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force, or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor’s plan for management of Site (for example, lay down and staging areas, construction traffic), use of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.07 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
    a. Contract Times, including Final Completion and all intermediate Milestones, are within the specified times.
    b. Specified Work sequences and constraints are shown as specified.
    c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
    d. Access restrictions are accurately reflected.
    e. Startup and testing times are as specified.
    f. Submittal review times are as specified.
    g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgment, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, including updating schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.08 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Deferred Submittal: Information, in accordance with 2009 IBC Section 107.3.4.2, submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.

C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

A. Direct submittals to Engineer at the following, unless specified otherwise.

1. Jacobs
   Attn: Rachel Grand
2. E-mail: Rachel.Grand@Jacobs.com

B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.

1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
3. PDF files shall be set to open "Bookmarks and Page" view.
4. Add general information to each PDF file, including title, subject, author, and keywords.
5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
6. Submit new electronic files for each resubmittal.

7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
8. Engineer will reject submittal that is not electronically submitted, unless specifically accepted.
9. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
10. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

C. Transmittal of Submittal:

1. Contractor shall:
    a. Review each submittal and check for compliance with Contract Documents.
    b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
        1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
        2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form in format approved by Engineer.
3. Identify each submittal with the following:
    a. Numbering and Tracking System:
        1) Sequentially number each submittal.
        2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
    b. Specification section and paragraph to which submittal applies.
    c. Project title and Engineer's project number.
    d. Date of transmittal.
    e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

D. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.

2. Package submittal information by individual specification section. Do not combine different specification sections together in submittal package, unless otherwise directed in specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual specification sections.

F. Processing Time:

1. Time for review shall commence on Engineer’s receipt of submittal.
2. Engineer will act upon Contractor’s submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.

G. Resubmittals: Clearly identify each correction or change made.

H. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor’s revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor’s review stamp; completed and signed.
   b. Transmittal of Contractor’s Submittal; completed and signed.
   c. Insufficient number of copies.

I. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped “Not Subject to Review.”
2. Engineer will keep one copy and return submittal to Contractor.

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual specification sections.

B. Shop Drawings:

1. Copies: Six, and one reproducible, except copyrighted documents.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual specifications.
5. Deferred Submittal: See Drawings for list of deferred submittals.
   a. Contractor-design drawings and product data related to permanent construction.
      1) Written and graphic information.
      2) Drawings.
      3) Cut sheets.
      4) Data sheets.
      5) Action item submittals requested in individual specification section.
   b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer. Documentation of review and approval provided on Engineer's comment form, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.
6. Foreign Manufacturers: When proposed, include names and addresses of at least two companies that maintain technical service representatives close to Project.

C. Samples:

1. Copies: Two, unless otherwise specified in individual specifications.

2. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
    a. Manufacturer name.
    b. Model number.
    c. Material.
    d. Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
    a. Size as indicated in individual specification section.
    b. Prepared from same materials to be used for the Work.
    c. Cured and finished in manner specified.
    d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:

1. Approved:
    a. Contractor may incorporate product(s) or implement Work covered by submittal.
    b. Distribution: Electronic.
        1) One copy furnished Owner.
        2) One copy furnished Resident Project Representative.
        3) One copy retained in Engineer's file.
2. Approved as Noted:
    a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    b. Distribution: Electronic.
        1) One copy furnished Owner.
        2) One copy furnished Resident Project Representative.
        3) One copy retained in Engineer's file.
3. Partial Approval, Resubmit as Noted:
    a. Make corrections or obtain missing portions, and resubmit.
    b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
    c. Distribution: Electronic.
        1) One copy furnished Owner.
        2) One copy furnished Resident Project Representative.
        3) One copy retained in Engineer's file.

d. Revise and Resubmit:
e. Contractor may not incorporate product(s) or implement Work covered by submittal.
f. Distribution: Electronic.
   1) One copy furnished Resident Project Representative.
   2) One copy retained in Engineer's file.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Submit three copies, unless otherwise indicated in individual specification section.
2. Refer to individual specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual specification section.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.

C. Construction Photographs and Video in accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.

D. Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.

E. Contractor-design Data (related to temporary construction):

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.
4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual specification section.

F. Deferred Submittals: See Drawings for list of deferred submittals.

1. Contractor-design data related to permanent construction:
   a. List of assumptions.
   b. List of performance and design criteria.
   c. Summary of loads or load diagram, if applicable.
   d. Calculations.
   e. List of applicable codes and regulations.
   f. Name and version of design software.
   g. Factory test results.
   h. Informational submittals requested in individual specification section.
2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer’s comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

G. Manufacturer’s Instructions: Written or published information that documents manufacturer’s recommendations, guidelines, and procedures in accordance with individual specification section.

H. Payment:

1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.

I. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

J. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.

K. Special Guarantee: Supplier's written guarantee as required in individual specification sections.

L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

M. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

N. Test, Evaluation, and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
    a. Identification of product and specification section, type of inspection or test with referenced standard or code.
    b. Date of test, Project title and number, and name and signature of authorized person.
    c. Test results.
    d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
    e. Provide interpretation of test results, when requested by Engineer.
    f. Other items as identified in individual specification sections.
3. Field:
    a. As a minimum, include the following:
        1) Project title and number.
        2) Date and time.
        3) Record of temperature and weather conditions.
        4) Identification of product and specification section.
        5) Type and location of test, Sample, or inspection, including referenced standard or code.
        6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
        7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
        8) Provide interpretation of test results, when requested by Engineer.
        9) Other items as identified in individual specification sections.

1.05 SUPPLEMENTS

A. The supplements listed below, following “End of Section”, are part of this specification.

1. Forms: Transmittal of Contractor’s Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
(ATTACH TO EACH SUBMITTAL)

DATE: ______________________________

TO:_______________________________________
____
____
____
____

FROM:_______________________________________
Contractor
____
____
____

Submittal No.:_______________________________
☐ New Submittal ☐ Resubmittal
Project:_______________________________
Project No.:_______________________________
Specification Section No.:_______________________
(Cover only one section with each transmittal)
Schedule Date of Submittal:
____

SUBMITTAL TYPE:	☐ Shop Drawing	☐ Sample	☐ Informational
	☐ Deferred		

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By:_______________________________________
Contractor (Authorized Signature)

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
   b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

A. Informational Submittals:

1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.

B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:

1. Relieve Contractor of responsibility for providing adequate quality control measures;
2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
3. Constitute or imply acceptance; or

4. Affect the continuing rights of Owner after acceptance of the completed Work.

C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.

E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.

B. Maintain complete inspection records and make them available at all times to Owner and Engineer.

C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.

B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor’s management and control with the Owner’s Quality Assurance.

C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may not perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.04 QUALITY CONTROL PHASING

A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:

1. Preparatory Phase:
    a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
    b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
    c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
    d. Perform prior to beginning Work on each definable feature of Work:
        1) Review applicable Contract Specifications.
        2) Review applicable Contract Drawings.
        3) Verify that all materials and/or equipment have been tested, submitted, and approved.
        4) Verify that provisions have been made to provide required control inspection and testing.
        5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
        6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
        7) Review the appropriate activity hazard analysis to verify safety requirements are met.
        8) Review procedures for constructing the Work, including repetitive deficiencies.
        9) Document construction tolerances and workmanship standards for that phase of the Work.
        10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
    a. Accomplish at the beginning of a definable feature of Work:
        1) Notify Owner at least 48 hours in advance of beginning the initial phase.
        2) Perform prior to beginning Work on each definable feature of Work:
            a) Review minutes of the preparatory meeting.
            b) Check preliminary Work to verify compliance with Contract requirements.
            c) Verify required control inspection and testing.
            d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
            e) Resolve all differences.
            f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
        3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
        4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
    a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
    b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
    c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
    a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
    b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
    c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
    d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
    e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.

C. Acceptance of Plans: Acceptance of the Contractor’s basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.

B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.

C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:

1. Contractor/subcontractor and their areas of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
5. Material received with statement as to its acceptability and storage.

6. Identify submittals reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts in Drawings and/or Specifications.
10. Contractor's verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

A. Testing Procedure:

1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
    a. Verify testing procedures comply with contract requirements.
    b. Verify facilities and testing equipment are available and comply with testing standards.
    c. Check test instrument calibration data against certified standards.
    d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
    e. Documentation:
        1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
        2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.

3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.
4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.

B. Punchlist:

1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
2. Federal Emergency Management Agency (FEMA).
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Utility Submittals:
   a. Electric power supply and distribution plans.
   b. Water supply and distribution plans.
   c. Dewatering well locations.
   d. Sanitary.
3. Temporary Construction Submittals:
   a. Access Roads: Routes, cross-sections, and drainage facilities.
   b. Parking area plans.
   c. Contractor’s field office, storage yard, and storage building plans, including gravel surfaced area.
   d. Fencing and protective barrier locations and details.
   e. Engineer’s field office plans.
   f. Staging area location plan.

4. Temporary Control Submittals:
   a. Noise control plan.
   b. Dust control plan.
   c. Plan for disposal of waste materials and intended haul routes.

1.03 MOBILIZATION

A. Mobilization includes, but is not limited to, these principal items:

   1. Obtaining required permits.
   2. Moving Contractor’s field office and equipment required for first month operations onto Site.
   3. Installing temporary construction power, wiring, and lighting facilities.
   4. Providing onsite Internet service.
   5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
   6. Arranging for and erection of Contractor’s work and storage yard.
   7. Posting OSHA required notices and establishing safety programs and procedures.
   8. Having Contractor’s superintendent at Site full time.
   9. Providing Engineer’s facilities.

B. Use area designated for Contractor’s temporary facilities as shown on Drawings.

C. Progress payment for mobilization will not be approved.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with Owner’s safety rules while on Owner’s property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

1.05 VEHICULAR TRAFFIC

A. Traffic Control Plan: Adhere to traffic control plan reviewed and accepted by Engineer. Changes to this plan shall be made only by written approval of Engineer. Secure approvals for necessary changes so as not to delay progress of the Work.

B. Traffic Routing Plan: Show sequences of construction affecting use of roadways, time required for each phase of the Work, provisions for decking over excavations and phasing of operations to provide necessary access, and plans for signing, barricading, and striping to provide passages for pedestrians and vehicles.

PART 2 PRODUCTS

2.01 ENGINEER’S FIELD OFFICES

A. Furnish equipment specified for exclusive use of Engineer and its’ representatives.

B. Ownership of equipment furnished under this article will remain, unless otherwise specified, that of Contractor.

C. Equipment furnished shall be new or like new in appearance and function.

D. Minimum Features:

1. 110-volt lighting and wall plugs.
2. Fluorescent ceiling lights.
3. Electric heating and self-contained air conditioning unit, properly sized for Project locale and conditions. Provide ample electric power to operate installed systems.
4. Provide railed stairways, and landings, and exterior lighting at entrances.
5. Exterior Door(s):
   a. Number: One.
   b. Type: Solid core.
   c. Lock(s): Cylindrical.
6. Number of Windows: Four.
7. Minimum Interior Height: 8 feet.

E. Plan table; plan rack; double desk with desk surface located 29 inches from floor; two 2-drawer, steel file cabinets; and overhead shelf.

F. Trailer Type Mobile Structure: One.

G. Floor Space: Minimum 425 square feet.

H. All-metal frame; all-metal exterior, sides, and roof; and insulated double walls, floor, and roof.

I. Security guard screens on windows.

J. Blinds or drapes on windows.

K. Work Surface: One, 30 inches by 10 feet at desk height of 29 inches from floor.

L. Office Equipment—General:

1. Bottled Water Service: One, with cooler capable of producing hot water and cold water.
2. Paper Towel Dispenser with Towels: One.
3. Desk: One, steel, 30 inches by 60 inches with desk surface located 29 inches from floor.
4. Desk Chair: One, with the following characteristics:
   a. Five castor base.
   b. Adjustable height.
   c. Swivels.
   d. Locking Back.
   e. Adjustable seat back for height and angle.
   f. Adjustable arms.
5. Folding Table: One, 36 inches by 72 inches.
6. Steel Folding Chairs: Two.
7. Drawing Rack with Drawing Hangers: One.
8. Wastepaper Basket: Two.
9. Blue Recycling Basket: Two.
10. Clothes Rack: One.
11. First-Aid Kit: One.
12. Tri-Class (ABC), Dry Chemical Fire Extinguisher, 10-Pound: One.

2.02 PROJECT SIGN

A. Provide and maintain one, 8-foot-wide by 4-foot-high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue applied on white background by an experienced sign painter. Include Owner’s and agency’s logos full color. Provide exterior type enamel paint. Information to be included and logo graphic will be provided by Owner.

PART 3 EXECUTION

3.01 ENGINEER’S FIELD OFFICE

A. Make available for Engineer’s use prior to start of the Work at Site and to remain on Site for minimum of 30 days after final acceptance of the Work.

B. Locate where directed by Engineer; level, block, tie down, skirt, provide stairways, and relocate when necessary and approved. Construct on proper foundations, and provide proper surface drainage and connections for utility services.

C. Provide minimum 100 square feet of gravel or crushed rock base, minimum depth of 4 inches, at each entrance.

D. Raise grade under field office, as necessary, to elevation adequate to avoid flooding.

E. Provide sanitary facilities in compliance with state and local health authorities.

F. Exterior Door Keys: Furnish two sets of keys.

G. Local Area Network (LAN):

1. Provide Ethernet network prewired in compliance with EIA/TIA 568B.
2. Ethernet wireless hub shall be capable of a minimum of four connections.
3. LAN shall be designed and installed by personnel experienced in similar LAN systems.

H. Telecommunications:

1. Provide cable Internet connection with minimum of five live portable computer (PC) ports.
2. Provide appropriate jacks, wiring, and equipment required for a complete telecommunications system.
3. Arrange and provide for telecommunication service for use during construction. Pay costs of installation, maintenance, and monthly service of internet connection.

I. Maintain in good repair and appearance, and provide weekly cleaning service and replenishment, as required, of paper towels, paper cups, hand soap, toilet paper, first-aid kit supplies, and bottled water.

J. Replenish, as needed, copy paper and toner.

3.02 TEMPORARY UTILITIES

A. Power:

1. No electric power is available at Site. Make arrangements to obtain and pay for electrical power used until final payment and acceptance by Owner, unless otherwise recommended by Engineer at Substantial Completion.
2. Cost of electric power will be borne by Contractor.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. No construction or potable water is available at Site. Make arrangements for and bear costs of providing water required for construction purposes and for drinking by construction personnel during construction.
2. Hydrant Water:
    a. Is available from nearby hydrants. Secure written permission for connection and use from water department and meet requirements for use. Notify fire department before obtaining water from fire hydrants.

b. Use only special hydrant-operating wrenches to open hydrants. Make certain hydrant valve is open full, since cracking valve causes damage to hydrant. Repair damaged hydrants and notify appropriate agency as quickly as possible. Hydrants shall be completely accessible to fire department at all times.
c. Include costs to connect and transport water to construction areas in Contract Price.

E. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.

F. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.03 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.

8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
10. Maintain original Site drainage wherever possible.

B. Signs and Equipment:

1. Conform to requirements of manual published by the Illinois Department of Transportation.
2. Portable TOW-AWAY-NO STOPPING Signs: Place where approved by police department and Owner.
3. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
4. High-Level Warning Flag Units: Provide two in advance of traffic approaching the Work, each displaying three flags mounted at a height of 9 feet.
5. Provide at obstructions, such as material piles and equipment.
6. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

C. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

D. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

E. Archaeological Finds:

1. General: Should finds of an archaeological or paleontological nature be made within Site limits, immediately notify Owner and Engineer and proceed in accordance with General Conditions. Continue the Work in other areas without interruption.

2. Archaeological Finds: Evidence of human occupation or use of an area within contract limits prior to the Year 1840. Evidence may consist of skeletons, stone, or other utensils, or evidence of habitations or structures.
3. Paleontological Finds: Evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.
4. Owner may order the Work stopped in other areas if, in Owner's opinion, find is more extensive than may appear from uncovered material.
5. Protection of Finds:
    a. Cover, fence, or otherwise protect finds until notice to resume the Work is given.
    b. Cover finds with plastic film held in place by earth, rocks, or other weights placed outside the find. Should additional backfilling be necessary for safety or to prevent caving, place backfill material loosely over plastic film.
    c. Sheet or shore as necessary to protect excavations underway. Place temporary fence to prevent unauthorized access.
    d. Dewater finds made below water table as necessary to protect construction Work underway. Divert groundwater or surface runoff away from find by ditching or other acceptable means.
6. Removal of Finds:
    a. Finds are property of Owner. Do not remove or disturb finds without Owner's written authorization.
    b. Should Owner elect to have a find removed, provide equipment, labor, and material to permit safe removal of find without damage. Provide transportation for delivery to individuals, institutions, or other places as Owner may find desirable, expedient, or required by law.

F. Endangered and Threatened Species:

1. Take precautions necessary and prudent to protect native endangered and threatened flora and fauna.
2. Notify Engineer of construction activities that might threaten endangered and threatened species or their habitats.
3. Contractor will mark areas known as habitats of endangered and threatened species prior to commencement of onsite activities.
4. Additional areas will be marked by Contractor as other habitats of endangered and threatened species become known during construction.

3.04 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.
3. Conduct operations of excavation and hauling in trucks to cause a minimum of dust. Give unpaved haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
2. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
3. Comply with Section 01 57 13, Temporary Erosion and Sedimentation Control, for stormwater flow and surface runoff.
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities as specified in Section 01 57 13, Temporary Erosion and Sedimentation Control, to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.05 STORAGE YARDS AND BUILDINGS

A. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

B. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.06 ACCESS ROADS

A. Construct access roads as shown and within easements, rights-of-way, or Project limits. Use existing roads where shown.

B. Maintain drainage ways. Install and maintain culverts to allow water to flow beneath access roads. Provide corrosion-resistant culvert pipe of adequate strength to resist construction loads.

C. Provide gravel, crushed rock, or other stabilization material to permit access by all motor vehicles at all times.

D. Maintain road grade and crown to eliminate potholes, rutting, and other irregularities that restrict access.

E. Coordinate with Engineer detours and other operations affecting traffic and access. Provide at least 72 hours' notice to Engineer of operations that will alter access to Site.

F. Upon completion of construction, restore ground surface disturbed by access road construction to original grade.

3.07 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on Project. No employee or equipment parking will be permitted on Owner's existing paved areas, except as specifically designated for Contractor's use.

3.08 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.

E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.

F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.

G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

I. Provide snow removal to facilitate normal vehicular traffic on public or private roads affected by construction. Perform snow removal promptly and efficiently by means of suitable equipment whenever necessary for safety, and as may be directed by proper authority.

J. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor’s night emergency telephone numbers to police department.

K. Coordinate traffic routing with that of others working in same or adjacent areas.

3.09 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 57 13
TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. This section covers Work to implement structural and nonstructural Best Management Practices (BMP) to control soil erosion by wind or water and keep eroded sediments and other construction-generated pollutants from moving off project sites. Requirements described in this specification and shown on the Drawings are part of the project Stormwater Pollution Prevention Plan (SWPPP) and are the minimum for all project construction sites and conditions. This specification covers all project activities, including material sources, disposal sites, and offsite mitigation areas unless specific project activities are excluded elsewhere in this specification or in other Contract Documents controlling the Work.

B. National Pollutant Discharge Elimination System: Comply with Federal, state, and local laws, rules and regulations, and the National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Discharge Permit or Permits applicable to the project. A copy of the Project's General Construction Permit, if applicable to the Project, is available from Owner. NPDES General Construction permits are required on projects that involve disturbance of 1 acre or more with potential to discharge stormwater to surface waters.

C. Other Regulations: A local government erosion and sediment control permit may apply and some local agency requirements may be more stringent than this specification. Adequate erosion and sediment control is essential for complying with the federal Endangered Species Act where construction runoff enters waters inhabited by protected species.

1.02 REFERENCES

A. Activities shall conform to the Illinois Erosion and Sediment Control Manual Standard Specifications, and Drawings. In the event of a conflict, the more stringent requirement shall apply.

B. The following is a list of standards that may be referenced in this section:

1. American Association of State Highway and Transportation Officials (AASHTO): M252, Standard Specification for Corrugated Polyethylene Drainage Pipe.

2. ASTM International (ASTM):
    a. D638, Standard Test Method for Tensile Properties of Plastics.
    b. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
    c. D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
    d. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
    e. D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
    f. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
    g. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
    h. D4632/D4632M, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
    i. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile
    j. D6241, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
    k. D6459, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
    l. D6460, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.
    m. D6475, Standard Test Method for Measuring Mass Per Unit Area of Erosion Control Blankets.
    n. D7322, Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Ability to Encourage Seed Germination and Plant Growth Under Bench-Scale Conditions.
    o. D7367, Standard Test Method for Determining Water Holding Capacity of Fiber Mulches for Hydraulic Planting.
3. National Weather Service:
    a. Precipitation-Frequency of the United States by State/Territory, 2012.
    b. Precipitation Frequency Data Server, 2012.
4. North American Weed Management Association (NAWMA).
5. U.S. Department of Agriculture, Natural Resources Conservation Service: *Urban Hydrology for Small Watersheds*; 1986. Technical Release 55.

6. U.S. Environmental Protection Agency:
   a. Developing Your Stormwater Pollution Prevention Plan: A Guide for Construction Sites, 2007. EPA-833-R-06-004.
   b. National Menu of BMPs, 2012.

1.03 SYSTEM DESCRIPTION

A. Erosion and Sediment Control:

1. Provide, maintain, and operate temporary facilities to control erosion and sediment releases during construction period.
2. Design erosion and sediment controls to handle peak runoff resulting from 25-year, 24-hour storm event based on National Weather Service: Precipitation Frequency Data Server.
3. Size temporary stormwater conveyances based on procedures presented in U.S. Department of Agriculture, Natural Resources Conservation Service: Urban Hydrology for Small Watersheds, 1986. Technical Release 55.

B. Erosion and Sediment Control (ESC) Lead:

1. Identify the ESC Lead at the preconstruction discussions and in the TESC Plan. The ESC Lead shall have certification in construction site erosion and sediment control from a course approved by Owner.
2. The ESC Lead shall implement the TESC Plan, including, but not limited to:
   a. Installing and maintaining all temporary erosion and sediment control Best Management Practices (BMPs) included in the TESC Plan to assure continued performance of their intended function. Damaged or inadequate TESC BMPs shall be corrected immediately.
   b. Updating TESC Plan to reflect current field conditions.
   c. Terminating TESC Plan.
3. When a TESC Plan is included in the Contract Plans, ESC Lead shall also inspect all areas disturbed by construction activities, all onsite erosion and sediment control BMPs, all stormwater discharge points, and all temporarily stabilized inactive sites per schedule in the Construction Stormwater Discharge Permit(s) or as directed by Engineer. Complete erosion and sediment control inspection form provided by water resource agency or Owner for each inspection and submit a copy to Engineer no later than end of the next working day following inspection.

C. Personnel Training: Prior to commencement of construction, applicable personnel must have an understanding of the Construction Stormwater Discharge Permit's requirements and their specific responsibilities under the permit. At a minimum, personnel must be trained to understand the following as it relates to the scope of their job duties:

  1. The location of all stormwater controls and how to maintain them.
  2. Procedures for complying with the pollution prevention requirements.
  3. Procedures for conducting inspections, recording findings, and taking corrective action.

D. Temporary Erosion and Sediment Control Plan (Stormwater Pollution Prevention Plan):

  1. A TESC Plan is furnished as part of the Drawings, which helps fulfill part of the plan requirement of the NPDES Permit. This initial TESC Plan, when adopted by Contractor, may be used as the basis of the construction TESC Plan. Additional or revised erosion and sediment control features, not shown on the initial TESC Plan, may be required depending on Contractor's methods of operation and schedule.
  2. For each phase of the scheduled work, indicate on the TESC Plan all the BMPs proposed and installed for erosion and sediment control to minimize clearing, stabilize exposed soil, divert or temporarily store flows, limit runoff from exposed areas, and filter transported sediment. Include all temporary slopes, constructed for staging or other reasons, which may not have been identified in the original Contract plans. Refer to the current local jurisdiction's erosion and sediment control manual.
  3. Some TESC Plan required elements typically required by NPDES permits:
     a. Narrative Site Description:
        1) Nature of construction activity planned for the Site.
        2) Estimates of total site area and the areas of the Site expected to be disturbed.
        3) Soil types found onsite and their erosion potential.
        4) The types of fill materials to be used.
        5) Timetable for sequence of major construction events.
     b. Site Map:
        1) All areas of development.
        2) Drainage patterns.
        3) Areas of soil disturbance, including pre-development and post-development elevation contours.
        4) Areas used for storage of soils or wastes.
        5) Areas where vegetative practices are to be implemented.

6) Location of all erosion and sediment control BMP or structures.
7) Location of all impervious structures and surfaces after project is completed.
8) Springs, wetlands, and other surface waters located onsite.
9) Boundaries of the 100-year floodplain, if determined.
10) Ordinary High Water line, if determined.
11) Location of storm drainage outfalls to receiving waters, if applicable.
12) Details of sediment and erosion controls.
13) Details of detention ponds, storm drain piping, inflow and outflow details.

c. Required BMPs and Procedures for Erosion Prevention, Runoff Control, and Sediment Control:

1) Construction entrances and parking areas.
2) Unpaved site roads such as haul roads.
3) Hauling saturated soils from the Site.
4) Water washed from concrete trucks.
5) Correct installation of erosion and sediment control BMPs.
6) Prompt maintenance and repair of BMPs.
7) Clearing and grading practices to minimize area of exposed soil throughout life of the Project.
8) Schedule of phased clearing operations to limit soils to what can be stabilized.
9) Vegetative practices, including preservation of existing vegetation, seeding, mulching, and buffer strips.
10) Preventing erosion of exposed areas.
11) Diverting flows from exposed slopes.
12) Limiting runoff from exposed areas.
13) Limiting sediment transport within work sites and keeping it from moving off of project areas.
14) Perimeter controls for all clearing and grubbing, both planned and installed.
15) Additional controls for wet season work and temporary work suspensions.
16) Sensitive areas such as wetlands.
17) Offsite material source and waste areas.
18) Dust.
19) Emergency materials stockpiled onsite.
20) Storing flows and filtering sediment.
21) Soil stockpiles.

4. Contractor’s construction TESC Plan and implementation schedules must be prepared by a competent individual. Furnish a signed copy of the TESC Plan with individual’s name, title, state certifications, and employing firm if different than Contractor’s firm.
5. Do not begin any Site activities that have potential to cause erosion or sediment movement until the TESC Plan and implementation schedules are approved by Engineer.
6. Keep a copy of the approved TESC Plan with updated changes onsite during all construction activities. During inactive periods longer than 7 calendar days, keep the TESC Plan onsite or provide a copy to Engineer to retain.
7. Continually update the TESC Plan and schedules as needed for unexpected storm or other events to ensure that sediment-laden water does not leave the construction site. Add approved changes to the TESC Plan no later than 24 hours after implementation.

E. Preventing erosion, and controlling runoff, sedimentation, and non-stormwater pollution, requires Contractor to perform temporary Work items including, but not limited to:

1. Providing ditches, berms, culverts, and other measures to control surface water.
2. Building dams, settling basins, energy dissipaters, and other measures, to control downstream flows.
3. Controlling underground water found during construction.
4. Covering or otherwise protecting slopes until permanent erosion control measures are working.

F. To the degree possible, coordinate this temporary Work with permanent drainage and erosion control work the Contract requires.

G. Engineer may require additional temporary control measures if it appears pollution or erosion may result from weather, nature of materials, or progress on the Work.

H. When natural elements rut or erode the slope, restore and repair damage with eroded material where possible, and remove and dispose of any remaining material found in ditches and culverts. When Engineer orders replacement with additional or other materials, unit Contract prices will cover quantities needed.

I. Install all sediment control devices including, but not limited to, sediment ponds, perimeter silt fencing, or other sediment trapping BMPs prior to any ground disturbing activity. Do not expose more erodible earth than necessary during clearing, grubbing, excavation, borrow, or fill activities without written approval by Engineer. Engineer may increase or decrease the limits based on project conditions. Erodible earth is defined as any surface where soils, grindings, or other materials may be capable of being displaced and transported by rain, wind, or surface water runoff. Cover inactive areas of erodible earth, whether at final grade or not, within specified time period (see [NPDES] Erosion and Sediment Control Permit), using an approved soil covering practice. Phase clearing and grading to maximum extent practical to prevent exposed inactive areas from becoming a source of erosion.

J. Water Management:

1. Manage site water in accordance with the conditions of the waste discharge permit from a local permitting authority. If site water management is not subject to permit, manage as follows:
   a. Groundwater. When groundwater is encountered in an excavation, treat and discharge as follows:
      1) When groundwater conforms to Illinois Water Quality Standards, it may bypass detention and treatment facilities and be routed directly to its normal discharge point at a rate and method that will not cause erosion.
      2) When turbidity of groundwater is similar to turbidity of site runoff, groundwater may be treated using same detention and treatment facilities being used to treat the site runoff and then discharged at a rate that will not cause erosion.
      3) When groundwater turbidity is greater than turbidity of site runoff, treat ground water separately until turbidity is similar to or better than site runoff, and then it may be combined with site runoff and treated as described above.
   b. Process Water:
      1) Do not discharge high pH process water or wastewater (non-stormwater) that is generated onsite, including water generated during concrete grinding, rubblizing, washout, and hydrodemolition activities, to waters of the Illinois, including wetlands. Water may be infiltrated upon approval of Engineer. Offsite disposal of concrete process water is subject to approval of Engineer.

2) Treat all water generated onsite from construction or washing activities that is more turbid than site runoff separately until turbidity is the same or less than site runoff, and then it may be combined with site runoff and treated as described above. Water may be infiltrated upon approval of Engineer.

c. Offsite Water: Prior to disruption of normal watercourse, intercept offsite stormwater and pipe it either through or around the Project Site. This water shall not be combined with onsite stormwater. Discharge offsite water at its preconstruction outfall point preventing an increase in erosion below the site. Submit proposed method for performing this Work for Engineer's approval.

K. Pollution Control: Use BMPs to prevent or minimize stormwater exposure to pollutants from spills; vehicle and equipment fueling, maintenance, and storage; other cleaning and maintenance activities; and waste handling activities. These pollutants include fuel, hydraulic fluid, and other oils from vehicles and machinery, as well as debris, leftover paints, solvents, and glues from construction operations. Implement the following BMPs when applicable:

1. Written spill prevention and response procedures.
2. Employee training on spill prevention and proper disposal procedures.
3. Spill kits in all vehicles.
4. Regular maintenance schedule for vehicles and machinery.
5. Material delivery and storage controls.
6. Training and signage.
7. Covered storage areas for waste and supplies.

L. If Engineer orders the Work suspended, continue to control erosion, pollution, and runoff during the shutdown.

M. Nothing in this section shall relieve Contractor from complying with other Contract requirements.

1.04 SUBMITTALS

A. Informational Submittals:

1. When a TESC Plan is included in the Drawings, either adopt or modify the TESC Plan. Provide a schedule for TESC Plan implementation and incorporate it into Contractor's progress schedule. Obtain Engineer's approval of the TESC Plan and schedule before any Work begins.
2. Modified TESC Plans shall meet all requirements of the applicable jurisdictions.

3. The TESC Plan shall cover all areas that may be affected inside and outside the limits of the Project (including all Owner-provided sources, disposal sites, and haul roads, and all nearby land, streams, and other bodies of water).
4. Allow at least 5 working days for Engineer to review any original or revised TESC Plan. Failure to approve all or part of any such Plan shall not make Owner liable to Contractor for any Work delays.

PART 2 PRODUCTS

2.01 CHECK DAMS

A. Specified by Contractor with approval of Engineer.

2.02 COIR LOG

A. Logs made of 100 percent durable coconut (coir) fiber uniformly compacted within woven netting.

B. Netting: Made of bristle coir twine with minimum strength of 80 pounds tensile strength. Nominal 2-inch by 2-inch openings.

C. Log Segments: Maximum length of 20 feet, with a minimum diameter as shown on the Drawings.

D. Log Minimum Density: 7 lbs/cf.

E. Stakes: Untreated softwood species with a notch to secure rope ties.

F. Rope Ties: 1/4-inch diameter commercially available hemp rope.

2.03 COMPOST SOCK

A. Provide socks fabricated from of extra heavy weight biodegradable fabric, with a minimum strand thickness of 5 mils.

B. Fill fabric with Coarse Compost.

C. Diameter: 8 inches minimum.

D. Fabric: Clean, evenly woven, and free of encrusted concrete or other contaminating materials. Shall be free from cuts, tears, broken or missing yarns. Shall be free of thin, open, or weak areas. Shall be free of any type of preservative.

E. Wood Stakes: Untreated softwood species, be 2-inch by 2-inch nominal dimension and 36 inches in length.

2.04 EROSION CONTROL BLANKET (MATTING), BIODEGRADABLE

A. Temporary erosion control blanket shall be made of natural plant fibers. Supply independent test results meeting the following:

Properties	ASTM Test Method	Requirements
Protecting Slopes from Rainfall-Induced Erosion	D6459: Test in one soil type. Soil tested shall be sandy loam as defined by the NRCS Soil Texture Triangle.	Maximum C factor of 0.15 using Revised Universal Soil Loss Equation (RUSLE)
Dry Weight per Unit Area	D6475	0.36 lb/sq. yd. minimum
Performance in Protecting Earthen Channels from Stormwater-Induced Erosion	D6460: Test in one soil type. Soil tested shall be loam as defined by the NRCS Soil Texture Triangle.	1.0 lb/sq. ft. minimum
Seed Germination Enhancement	D7322	200 percent minimum
Netting, if present, shall be biodegradable with a life span not to exceed 1 year.		

B. For permanent erosion control blanket, see Section 31 32 00, Soil Stabilization.

2.05 GEOTEXTILE

A. Geotextiles shall consist only of long chain polymeric fibers or yarns formed into a stable network such that the fibers or yarns retain their position relative to each other during handling, placement, and design service life. At least 95 percent by weight of the material shall be polyolefins or polyesters. The material shall be free from defects or tears. Geotextile shall also be free of any treatment or coating which might adversely alter its hydraulic or physical properties after installation. Geotextile properties shall be as specified in Section 31 32 19.16, Geotextile, or as described in Table 1 through Table 3.

Table 1
Geotextile for Permanent Erosion Control

Geotextile Property	ASTM Test Method	Geotextile Property Requirements					
		Permanent Erosion Control				Ditch Lining	
		Moderate Survivability		High Survivability			
		Woven	Nonwoven	Woven	Nonwoven	Woven	Nonwoven
AOS	D4751	See Table 2		See Table 2		U.S. No. 30 max.	
Water Permittivity	D4491	See Table 2		See Table 2		0.02 sec^{-1} min.	
Grab Tensile Strength, in machine and x-machine direction	D4632/ D4632M	250 lb min.	160 1b min.	315 lb min.	200 lb min.	250 lb min.	160 lb min.
Grab Failure Strain, in machine and x-machine direction	D4632/ D4632M	15% -50%	≥50%	15% -50%	≥50%	<50%	≥50%
Seam Breaking Strength	D4632/ D4632M	220 lb min.	140 lb min.	270 lb min.	180 lb min.	220 lb min.	140 lb min.
Puncture Resistance	D6241	495 lb min.	310 lb min.	620 lb min.	430 lb min.	495 lb min.	310 lb min.
Tear Strength, in machine and x-machine direction	D4533	80 lb min.	50 lb min.	112 lb min.	79 lb min.	80 lb min.	50 lb min.
Ultraviolet (UV) Radiation Stability	D4355	70% strength retained min., after 500 hours in xenon arc device					

Table 2
Filtration Properties for Geotextile for Permanent Erosion Control

Geotextile Property	ASTM Test Method	Geotextile Property Requirements		
		Class A	Class B	Class C
AOS	D4751	U.S. No. 40 max.	U.S. No. 60 max.	U.S. No. 70 max.
Water Permittivity	D4491	0.7 sec^{-1} min.	0.4 sec^{-1} min.	0.2 sec^{-1} min.

Table 3
Geotextile for Temporary Silt Fence

Geotextile Property	ASTM Test Method	Geotextile Property Requirements: Unsupported Between Posts	Geotextile Property Requirements: Supported Between Posts with Wire or Polymeric Mesh
AOS	D4751	U.S. No. 30 max. for silt wovens, U.S. No. 50 for all other geotextile types, U.S. No. 100 min.	
Water Permittivity	D4491	0.2 sec^{-1} min.	
Grab Tensile Strength, in machine and x-machine direction	D4632/ D4632M	180 lb min. in machine direction, 100 lb min. in x-machine direction	100 lb min.
Grab Failure Strain, in machine and x-machine direction	D4632/ D4632M	30% max. at 180 lb or more	
Ultraviolet (UV) Radiation Stability	D4355	70% strength retained min., after 500 hours in xenon arc device	

2.06 GRAVEL FILTER, WOOD CHIP OR COMPOST BERM

A. Rock Material Used for Filter Berms: Clean 3/4-inch rock, with no recycled materials.

B. Wood Chips Used for Wood Chip Berm: As specified in Article Wood Chips and Wood Shavings.

C. Compost Used for Compost Berms: Coarse compost as specified in Article Compost Blanket.

2.07 MULCH

A. Short-Term: Provide independent test results documenting that the mulch meets the requirements in Table 4, Short-Term Mulch Test Requirements.

Table 4
Short-Term Mulch Test Requirements

Properties	Test Method	Requirements
Performance in Protecting Slopes from Rainfall-Induced Erosion.	ASTM D6459. Test in one soil type. Soil tested shall be sandy loam as defined by the National Resources Conservation Service (NRCS) Soil Texture Triangle.	C Factor = 0.15 maximum using Revised Universal Soil Loss Equation (RUSLE)

B. Moderate-Term: Within 48 hours of application, the Moderate-Term Mulch shall bond with soil surface to create a continuous, absorbent, flexible, erosion-resistant blanket that allows for seed germination and plant growth and conforms to the requirements in Table 5, Moderate-Term Mulch Test Requirements. Provide test results documenting that the mulch meets the requirements in Table 5, Moderate-Term Mulch Test Requirements. Supply independent test results.

Table 5
Moderate-Term Mulch Test Requirements

Properties	Test Method	Requirements
Performance in Protecting Slopes from Rainfall-Induced Erosion.	ASTM D6459. Test in one soil type. Soil tested shall be sandy loam as defined by the NRCS Soil Texture Triangle.	C Factor = 0.05 maximum using Revised Universal Soil Loss Equation (RUSLE)

C. Long-Term:

1. Provide Long-Term Mulch with demonstrated ability:
   a. To adhere to soil and create a blanket-like mass within 2 hours of application.
   b. To bond with the soil surface to create a continuous, porous, absorbent, and flexible erosion-resistant blanket that allows for seed germination and plant growth.
   c. To conform to the requirements in Table 6, Long-Term Mulch Test Requirements.
   d. Provide test results documenting that mulch meets requirements in Table 6, Long-Term Mulch Test Requirements. Supply independent test results.

Table 6
Long-Term Mulch Test Requirements

Properties	Test Method	Requirements
Performance in Protecting Slopes from Rainfall-Induced Erosion.	ASTM D6459. Test in one soil type. Soil tested shall be sandy loam as defined by the NRCS Soil Texture Triangle.	C Factor = 0.01 maximum using Revised Universal Soil Loss Equation (RUSLE)

2.08 PLASTIC COVERING

A. Clear plastic meeting requirements of ASTM D4397 for polyethylene sheeting having a minimum thickness of 6 mils.

2.09 POLYACRYLAMIDE (PAM)

A. Meet ANSI/NSF Standard 60 for drinking water treatment with an AMD content not to exceed 0.05 percent.

B. Anionic, linear, and not cross-linked.

C. Minimum average molecular weight greater than 5 mg/mole and minimum 30 percent charge density.

D. 80 percent active ingredients minimum with moisture content not exceeding 10 percent by weight.

E. Delivered in a dry granular or powder form.

2.10 SEDIMENT CONTROL BARRIERS

A. Specified by Contractor with approval of Engineer. May include Compost Filter Sock or Compost Filter Berm.

2.11 SEEDING

A. See Section 32 92 00, Turf and Grasses.

2.12 SILT (SEDIMENT) FENCE

A. Geotextile: As specified in Article Geotextile.

B. Support Posts: As recommended by manufacturer of geotextile.

C. Fasteners: Heavy-duty wire staples at least 1-inch long, tie wires, or hog rings, as recommended by manufacturer of geotextile.

2.13 STABILIZED CONSTRUCTION ENTRANCE

A. Construct a pad from stone 3 inches to 6 inches in size, placed at least 8 inches deep and not less than 50 feet long.

B. Provide aggregate free of extraneous materials that may cause or contribute to track out.

C. Place separation geotextile under the rock to prevent fine sediment from pumping up into the rock pad. See Article Geotextile for required geotextile properties.

D. Use of constructed or constructed/manufactured steel plates with ribs (such as, shaker/rumble plates or corrugated steel plates) for entrance/exit access is allowable.

2.14 STRAW BALE BARRIER

A. Straw:

1. Air dried condition free of noxious weeds, seeds, and other materials detrimental to plant life. Hay is not acceptable. Provide weed-free documentation:
   a. Certified Weed Free Straw using North American Weed Management Association (NAWMA) standards.
   b. Provide documentation that material is steam or heat treated to kill seeds.
   c. Provide U.S. or state's Department of Agriculture laboratory test reports, dated within 90 days prior to date of application, showing there are no viable seeds in the straw.

B. Straw Mulch: Suitable for spreading with mulch blower equipment.

C. Posts for Straw Bales: 2-inch by 2-inch untreated wood or commercially manufactured metal posts.

2.15 STREET CLEANING

A. Use self-propelled pickup street sweeper(s). Mechanical broom sweepers are not allowed where environmental concerns exist about storm water pollution or air quality.

2.16 TACKIFIERS

A. Biodegradable Hydraulically Applied Erosion Control Products (HECPs) in a dry condition, free of noxious weeds, seeds, chemical printing ink, germination inhibitors, herbicide residue, chlorine bleach, rock, metal, plastic, and other materials detrimental to plant life. Up to 5 percent by weight may be photodegradable material.

B. Suitable for spreading with a hydroseeder.

C. Furnish HECPs premixed by the manufacturer. Under no circumstances will field mixing of additives or components be acceptable.

D. Provide test results, dated within 3 years prior to the date of application, from an independent, accredited laboratory, as approved by Engineer, showing that the product meets the HECP requirements in Table 7.

Table 7
HECP Requirements

Properties	Test Method	Requirements	
Acute Toxicity	EPA-821-R-02-012 Methods for Measuring Acute Toxicity of Effluents. Test leachate from recommended application rate receiving 2 inches of rainfall per hour using static test for No-Observed-Adverse-Effect-Concentration (NOEC).	Four replicates are required with no statistically significant reduction in survival in 100 percent leachate for a Daphnid at 48 hours and Oncorhynchus mykiss (rainbow trout) at 96 hours.	
Solvents	EPA 8260B	Benzene:	< 0.03 mg/kg
		Methylene chloride:	< 0.02 mg/kg
		Naphthalene:	< 5 mg/kg
		Tetrachloroethylene:	< 0.05 mg/kg
		Toluene:	< 7 mg/kg
		Trichloroethylene:	< 0.03 mg/kg
		Xylenes:	< 9 mg/kg
Heavy Metals	EPA 6020A Total Metals	Antimony:	< 4 mg/kg
		Arsenic:	< 6 mg/kg
		Barium:	< 80 mg/kg
		Boron:	< 100 mg/kg
		Cadmium:	< 2 mg/kg
		Chromium:	< 2 mg/kg
		Copper:	< 5 mg/kg
		Lead:	< 5 mg/kg
		Mercury:	< 2 mg/kg
		Nickel:	< 2 mg/kg
		Selenium:	< 10 mg/kg
		Strontium:	< 30 mg/kg
		Zinc:	< 5 mg/kg

Table 7
HECP Requirements

Properties	Test Method	Requirements
Water Holding Capacity	ASTM D7367	900 percent minimum
Organic Matter Content	ASTM D2974	90 percent minimum
Moisture Content	ASTM D2974	15 percent
Seed Germination Enhancement	ASTM D7322	Long-Term: 420 percent minimum Moderate-Term: 400 percent minimum Short-Term: 200 percent minimum

2.17 TIRE WASH FACILITY

A. Specified by Contractor with approval of Engineer. Wheel wash facilities should have a non-erosive base, and a small grade change, 6 inches to 12 inches for a 10-foot-wide pond, to allow sediment to flow to low side of pond to help prevent re-suspension of sediment. A drainpipe with a 2-foot to 3-foot riser should be installed at low side of pond to allow for cleaning and refilling. Pond should be deep enough to hold 14 inches of water after displacement. Alternatively, pressure washing combined with an adequately-sized and adequately-surfaced pad with direct drainage to a 10-foot by 10-foot sump can be very effective.

2.18 WATTLES

A. Cylinders of biodegradable plant material such as weed-free straw, coir, compost, wood chips, excelsior, or wood fiber or shavings encased within biodegradable netting.

B. Diameter: 5 inches minimum.

C. Netting Material: Clean, evenly woven, and free of encrusted concrete or other contaminating materials such as preservatives. Also free from cuts, tears, or weak places with a minimum lifespan of 6 months.

D. Compost Filler: Coarse compost, wood chips, or wood shavings.

E. Wood Stakes: Untreated softwood species, 2-inch by 2-inch nominal dimension and 36 inches in length.

PART 3 EXECUTION

3.01 PREPARATION

A. Engineer's acceptance of the TESC Plan is required prior to starting earth disturbing activities.

B. Include proposed stockpile areas and installation of temporary erosion control devices, ditches, or other facilities in Work phasing plans.

C. Areas designated for Contractor's use during Project may be temporarily developed as specified to provide working, staging, and administrative areas. Include control of sediment from these areas in the TESC Plan.

D. Check Dams: Install check dams as soon as construction will allow, or when designated by Engineer. Contractor may substitute a different check dam, in lieu of what is specified in the Contract, with approval of Engineer. Check dam is a temporary or permanent structure, built across a minor channel. Water shall not flow through check dam structure. Construct check dams to create a ponding area upstream of dam to allow pollutants to settle, with water from increased flows channeled over a spillway in check dam. Construct check dam to prevent erosion in area below spillway. Place check dams perpendicular to flow of water and install in accordance with the Drawings. Extend outer edges up sides of conveyance to prevent water from going around check dam. Provide check dams of sufficient height to maximize detention, without causing water to leave ditch. Place sandbags so that initial row makes tight contact with ditch line for length of dam. Stagger subsequent rows so center of bag is placed over space between bags on previous lift.

E. Coir Log: Install coir logs in accordance with the Drawings.

F. Compost Sock: Exercise care when installing compost socks to ensure method of installation minimizes disturbance of waterways and prevents sediment or pollutant discharge into waterbodies. Lace compost socks together, end-to-end, with coir rope to create a continuous length. Bury loose ends of continuous length 3 feet to 5 feet laterally into the bankslope. Install the upper surface of compost sock parallel to slope. Provide finished grades of a natural appearance with smooth transitions. Secure compost sock with wood stakes or live stakes of species as indicated on the Drawings. Drive stakes into place centered on top of compost sock and spaced 3 feet on center throughout length of sock.

G. Erosion Control Blanket (Matting), Biodegradable: Temporary Erosion Control Blankets are used as an erosion prevention device and to enhance establishment of vegetation. Install erosion control blankets according to manufacturer's recommendations.

1. Erosion control blankets with an open area of 60 percent or greater may be installed prior to seeding and fertilizing. Install blankets with less than 60 percent open space immediately following seeding and fertilizing operation.
2. Select erosion control blanket material for an area based on the intended function; slope or ditch stabilization and Site-specific factors including soil, slope gradient, rainfall, and flow exposure. Do not use erosion Control Blankets on slopes or in ditches that exceed manufacturer's recommendations.
3. For permanent erosion control blanket, see Section 31 32 00, Soil Stabilization.

H. Gravel Filter, Wood Chip, or Compost Berm: Construct filter berms to retain sediment and direct flows.

1. Gravel Filter Berm: 1-foot minimum height. Maintain at this height for entire time berm is in use.
2. Wood Chip Berm: 2-foot minimum height. Maintain at this height for entire time berm is in use.
3. Construct compost berm of course compost in accordance with the detail on the Drawings.

I. Mulch: Furnish, haul, and evenly apply at rates indicated and spread on seeded areas within 48 hours after seeding unless otherwise specified.

1. Distribute straw mulch material with an approved mulch spreader that uses forced air to blow mulch material on seeded areas.
2. Apply wood strand mulch by hand or by straw blower on seeded areas.
3. Hydraulically apply Short-Term Mulch at the rate of 2,500 pounds per acre. May be applied in one lift.
4. Hydraulically apply Moderate-Term Mulch and Long-Term Mulch at the rate of 3,500 pounds per acre with no more than 2,000 pounds applied in any single lift. Mulch may be applied with seed and fertilizer in moist climates. In dry climates, apply seed and fertilizer in a single application followed by mulch application. Provide mulch suitable for application with a hydroseeder.

5. Cover temporary seed applied outside application windows established in Section 32 92 00, Turf and Grasses, with a mulch containing either Moderate-Term Mulch or Long-Term Mulch, as designated by Engineer.
6. Mulch areas not accessible by mulching equipment by approved hand methods.

J. Plastic Covering: Use clear plastic covering to promote seed germination when seeding is performed outside of specified dates. Use black plastic covering for stockpiles or other areas where vegetative growth is unwanted. Place plastic with at least a 12-inch overlap of all seams. Install and maintain plastic cover tolon prevent water from cutting under the plastic and to prevent cover from blowing open in the wind.

K. Polyacrylamide (PAM): See Tackifiers.

L. Sediment Control Barriers: Install sediment control barriers in accordance with TESC Plan or manufacturer's recommendations in the areas of clearing, grubbing, earthwork, or drainage prior to starting those activities. Maintain sediment control barriers until soils are stabilized.

M. Seeding: See Section 32 92 00, Turf and Grasses.

N. Silt (Sediment) Fence:

1. Silt fence shall be installed in accordance with the Drawings. When backup support is used, use steel wire with a maximum mesh spacing of 2 inches by 4 inches, or plastic mesh as resistant to ultraviolet radiation as the geotextile it supports. Provide wire or plastic mesh with strength equivalent to or greater than as required for unsupported geotextile (for example, 180 pounds grab tensile strength in the machine direction).
2. Attach geotextile to posts and support system using staples, wire, or in accordance with manufacturer's recommendations. Geotextile shall be sewn together at the point of manufacture, or at a location approved by Engineer, to form geotextile lengths as required.
3. Provide wood or steel support posts at sewn seams and overlaps and as shown on the Drawings and necessary to support fence.
4. Wood Posts: Minimum dimensions of 1-1/4-inch by 1-1/4-inch by the minimum length shown on the Drawings.
5. Steel Posts: Minimum weight of 0.90 lb/ft.
6. When sediment deposits reach approximately one-third the height of the silt fence, remove and stabilize deposits.

O. Stabilized Construction Entrance: Construct temporary stabilized construction entrance in accordance with the Drawings, prior to beginning any clearing, grubbing, earthwork, or excavation. When stabilized entrance no longer prevents track out of sediment or debris, either rehabilitate existing entrance to original condition or construct a new entrance.

P. Street Cleaning: Use self-propelled pickup street sweepers whenever required by Engineer to prevent transport of sediment and other debris off Project Site. Provide street sweepers designed and operated to meet air quality standards. Street washing with water will require approval by Engineer. Intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.

Q. Tackifiers:

1. Mix and apply tackifier in accordance with manufacturer’s recommendations. If applied with a hydroseeder, add Short-Term Mulch as a tracer at a rate of 125 pounds to 250 pounds per acre to visibly aid uniform application.
2. Soil Binding Using Polyacrylamide (PAM): Apply PAM on bare soil completely dissolved and mixed in water or applied as a dry powder. Apply dissolved PAM at a rate of not more than 2/3 pound per 1,000 gallons of water per acre. Apply a minimum of 200 pounds per acre of Short-Term Mulch with the dissolved PAM. Dry powder applications may be at a rate of 5 pounds per acre using a hand-held fertilizer spreader or a tractor-mounted spreader.
   a. Apply PAM only to areas that drain to completed sedimentation control BMPs in accordance with the TESC Plan. PAM may be reapplied on actively worked areas after a 48-hour period.
   b. PAM shall not be applied during rainfall or to saturated soils.

R. Tire Wash Facility: When the Contract requires a tire wash (in conjunction with a stabilized entrance), include details for tire wash and method for containing and treating sediment-laden runoff as part of the TESC Plan. All vehicles leaving the Site shall stop and wash sediment from their tires. Keep the water level 12 inches to 14 inches deep. Change wash water a minimum of once per day. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 pound to 0.5 pound per 1,000 gallons of water increases effectiveness and reduces cleanup time.

S. Wattles: Install wattles as soon as construction will allow or when designated by Engineer. Begin trench construction and wattle installation at base of slope and work uphill. Spread excavated material evenly along the uphill slope and compact using hand tamping or other method approved by Engineer. On gradually sloped or clay-type soils, provide trenches 2 inches to 3 inches deep. On loose soils, in high rainfall areas, or on steep slopes, provide trenches 3 inches to 5 inches deep, or half the thickness of the wattle. Exercise care when installing wattles to minimize disturbance of waterways and prevent sediment or pollutant discharge into waterbodies.

3.02 ADDITIONAL REQUIREMENTS

A. Natural Buffer or Equivalent:

1. Unless natural buffer between the Project Site and receiving waters has previously been eliminated by pre-existing development disturbances, comply with one of the following alternatives if stormwater from construction will discharge to surface water:
   a. Provide a 50-foot, undisturbed natural buffer between construction disturbances and surface water.
   b. Provide an undisturbed natural buffer that is less than 50 feet supplemented by additional erosion and sediment controls, which in combination, achieve a sediment load reduction that is equivalent to a 50-foot buffer.
   c. If it is infeasible to provide an undisturbed natural buffer of any size, implement erosion and sediment controls that achieve a sediment load reduction that is equivalent to a 50-foot buffer.

3.03 MAINTENANCE

A. The ESCP measures described in this specification are minimum requirements for anticipated Site conditions. During the construction period, upgrade these measures as needed to comply with all applicable local, state, and federal erosion and sediment control regulations.

B. Maintain erosion and sediment control BMPs so they properly perform their function until Engineer determines they are no longer needed.

C. Construction activities must avoid or minimize excavation and creation of bare ground during wet weather.

D. The intentional washing of sediment into storm sewers or drainage ways must not occur. Vacuuming or dry sweeping and material pickup must be used to cleanup released sediments.

E. Inspect BMPs in accordance with the schedule in the Construction Stormwater Discharge Permit(s) or as directed by Engineer.

F. Complete an inspection report within 24 hours of an inspection. Each inspection report shall be signed and identify corrective actions. Document that corrective actions are performed within 7 days of identification. Keep a copy of all inspection reports at the Site or at an easily accessible location.

G. Unless otherwise specified, remove deposits before the depth of accumulated sediment and debris reaches approximately height of BMP. Dispose of debris or contaminated sediment at approved locations. Clean sediments may be stabilized onsite using BMPs as approved by Engineer.

H. Sediment Fence: Remove trapped sediment before it reaches one-third of the above ground fence height and before fence removal.

I. Other Sediment Barriers (such as biobags): Remove sediment before it reaches 2 inches depth above ground height and before BMP removal.

J. Initiate repair or replacement of damaged erosion and sediment control BMPs immediately, and work completed by end of next work day. Significant replacement or repair must be completed within 7 days, unless infeasible.

K. Within 24 hours, remediate any significant sediment that has left construction site. Investigate cause of the sediment release and implement steps to prevent a recurrence of discharge within same 24 hours. Perform in-stream cleanup of sediment according to applicable regulations.

L. At end of each work day, stabilize or cover soil stockpiles or implement other BMPs to prevent discharges to surface waters or conveyance systems leading to surface waters.

M. Temporarily stabilize soils at end of shift before holidays and weekends, if needed. Ensure soils are stable during rain events at all times of year.

N. Initiate stabilization by no later than end of next work day after construction work in an area has stopped permanently or temporarily.

O. Within 14 days of initiating stabilization or as specified in permit, either seed or plant stabilized area (see Section 32 92 00, Turf and Grasses); or apply non-vegetative measures and cover all areas of exposed soil. Seed dry areas as soon as Site conditions allow. Ensure that vegetation covers at least 70 percent of stabilized area. In areas where Contractor's activities have compromised erosion control functions of existing grasses, over-seed existing grass. Non-vegetative measures may include blown straw and a tackifier, loose straw, or an adequate covering of compost mulch. Complete initial stabilization within 7 days if storm water discharges to surface waters impaired for sediment or nutrients, or high quality waters.

P. Provide permanent erosion control measures on all exposed areas. Do not remove temporary sediment control practices until permanent vegetation or other cover of exposed areas is established. However, do remove all temporary erosion control measures as exposed areas become stabilized, unless doing so conflicts with local requirements. Properly dispose of construction materials and waste, including sediment retained by temporary BMPs.

3.04 REMOVAL

A. When Engineer determines that an erosion control BMP is no longer required, remove BMP and all associated hardware from the Project limits. When materials are biodegradable, Engineer may approve leaving temporary BMP in place.

B. Permanently stabilize all bare and disturbed soil after removal of erosion and sediment control BMPs. Dress sediment deposits remaining after BMPs have been removed to conform to existing grade. Prepare and seed graded area. If installation and use of erosion control BMPs have compacted or otherwise rendered soil inhospitable to plant growth, such as construction entrances, take measures to rehabilitate soil to facilitate plant growth. This may include, but is not limited to, ripping the soil, incorporating soil amendments, or seeding with specified seed.

3.05 MEASUREMENT AND PAYMENT

A. Check Dams will be measured per linear foot one time only along the completed check dam. Unit Contract Price per linear foot for Check Dam shall be full pay for all equipment, labor, and materials to perform the Work as specified, including installation, removal, and disposal at an approved disposal site. No additional measurement will be made for check dams required to be rehabilitated or replaced as a result of wear.

B. Coir Log will be measured by linear foot along ground line of completed installation. Unit Contract Price per linear foot for Coir Log shall be full pay for all equipment, labor, and materials to perform the Work as specified, including installation, removal, and disposal at an approved disposal site.

C. Compost Sock will be measured by linear foot. Unit Contract Price for Compost Sock shall include removal and disposal of compost sock fabric if photodegradable fabric is not used.

D. Erosion Control Blanket (matting) will be measured by square yard along ground slope line of surface area covered and accepted. Unit Contract price per square yard for Erosion Control Blanket shall be full pay for all costs to complete the specified Work.

E. ESC Lead will be measured per day for each day that an inspection is made and a report is filed.

F. Gravel Filter, Wood Chip, or Compost Berm will be measured by linear foot along ground line of completed installation. Unit Contract Price per linear foot of berm shall be full pay for all equipment, labor, and materials to perform the Work as specified, including installation, removal, and disposal at an approved disposal site.

G. Mulch will be measured by the acre by ground slope measurement or through use of design data.

H. Natural Buffer or Equivalent: No additional payment will be made for providing a Natural Buffer or Equivalent on the Project Site.

I. Plastic Covering will be measured by the square yard along ground slope line of surface area covered and accepted. Unit Contract Price per square yard for Plastic Covering shall be full pay for all equipment, labor, and materials to perform the Work as specified, including removal and disposal at an approved disposal site.

J. Polyacrylamide (PAM). See Tackifiers.

K. Sediment Control Barrier will be measured by linear foot along ground line of completed barrier.

L. Seeding: See Section 32 92 00, Turf and Grasses.

M. Silt (Sediment) Fence will be measured by linear foot along ground line of completed installation.

N. Stabilized Construction Entrance will be measured by square yard for each entrance constructed.

O. Street Cleaning will be measured by the hour for actual time spent cleaning pavement, as authorized by Engineer. Time to move equipment to or from the area on which street cleaning is required, will not be measured.

P. Tackifiers (Polyacrylamide) will be measured by the acre by ground slope measurement or calculated by use of design data. Unit Contract Price per acre for Tackifier shall be full payment for all costs incurred to complete the Work.

Q. Tire Wash facility will be measured per each for each wash installed. Unit Contract Price per each for tire wash shall include all costs associated with constructing, operating, maintaining, and removing the tire wash.

R. Wattles will be measured by the linear foot.

S. Erosion Control will be measured and paid on a lump sum basis. Erosion Control includes:

1. Providing the ESC Lead.
2. Developing, revising, and documenting TESC Plan.
3. Mobilization.
4. Monitoring activities.
5. Furnishing, stockpiling, protecting, restocking, and removing emergency materials.
6. Preparing Project for winter shutdown.
7. Inspecting, maintaining, and removing erosion control devices.
8. Restoring, mulching, tacking, and seeding all disturbed ground, work, and storage areas not otherwise covered.

T. No separate or additional payment will be made for:

1. Removing and disposing of sediment build-up behind sediment fences and sediment barriers.
2. Removing and reinstalling required appurtenances to modify temporary slope drains as the embankment slopes are changed.
3. Constructing and removing temporary slope berms.
4. Applying dust control.
5. Erosion control for work outside construction limits including, but not limited to, borrow pits, haul roads, disposal sites, and equipment storage sites.

U. When only Erosion Control is listed in the Contract Schedule of Items, no separate or additional payment will be made for modifications or additions to the BMPs that become necessary for permit compliance during construction.

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
    a. Record Documents: As required in General Conditions.
    b. Special bonds, Special Guarantees, and Service Agreements.
    c. Consent of Surety to Final Payment: As required in General Conditions.
    d. Releases or Waivers of Liens and Claims: As required in General Conditions.
    e. Releases from Agreements.
    f. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01 29 00, Payment Procedures.
    g. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
    a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
    b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.

4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Engineer at no cost to Contractor, one complete set of Contract Documents. Drawings will be full size.

2. Label or stamp each record document with title, “RECORD DOCUMENTS,” in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by “cloud” drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer’s written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as “cast iron drain,” “galv. water,” and the like.
   b. Show, by symbol or note, vertical location of item (“under slab,” “in ceiling plenum,” “exposed,” and the like).
   c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor’s request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor’s notice of completion, clean entire Site or parts thereof, as applicable.

   1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
   2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
   3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
   4. Decontaminate sidewalks, loading areas, and others contiguous with principal structures.
   5. Rake clean all other surfaces.
   6. Remove snow and ice from access to buildings.
   7. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SUBMITTALS

A. Action Submittals: Drawings clearly showing clearing, grubbing, and stripping limits.

1.03 QUALITY ASSURANCE

A. Obtain Engineer’s approval of staked clearing, grubbing, and stripping limits, prior to commencing clearing, grubbing, and stripping.

1.04 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls to maximum of 5 acres.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. Project limits are shown on the Contract Drawings.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

B. Fell trees so that they fall away from facilities and vegetation not designated for removal.

C. Cut stumps not designated for grubbing to within 6 inches of ground surface.

D. Cut off shrubs, brush, weeds, and grasses to within 2 inches of ground surface.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits shown or specified.

3.06 STRIPPING

A. Do not remove topsoil until after scalping is completed.

B. Strip areas within limits to minimum depths shown or specified. Do not remove subsoil with topsoil.

C. Stockpile strippings, meeting requirements of Section 32 91 13, Soil Preparation, for topsoil, separately from other excavated material.

3.07 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Woody debris may be chipped. Chips may be sold to Contractor's benefit or used for landscaping onsite as mulch or uniformly mixed with topsoil, provided that resulting mix will be fertile and not support combustion. Maximum dimensions of chipped material used onsite shall be 1/4 inch by 2 inches. Dispose of chips that are unsaleable or unsuitable for landscaping or other uses with unchipped debris.

B. Scalpings: As specified for clearing and grubbing debris.

C. Strippings:

1. Dispose of strippings that are unsuitable for topsoil or that exceed quantity required for topsoil in consolidation area.
2. Stockpile topsoil in sufficient quantity to meet Project needs. Dispose of excess strippings as specified for clearing and grubbing.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).
   b. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   c. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 31 23 23, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 31 23 23, Fill and Backfill.

D. Relative Density: As defined in Section 31 23 23, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Sections 02 41 00, Demolition; 31 10 00, Site Clearing; and 31 23 16, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

A. Under General Site Fill: Two passes with a three-wheeled power roller weighing approximately 10 tons.

B. Within Consolidation Area: Compact upper 6 inches to minimum of 98 percent relative compaction as determined in accordance with ASTM D698.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 TESTING

A. Proof-roll subgrade with equipment specified in Article Compaction to detect soft or loose subgrade or unsuitable material, as determined by Engineer.

B. Nuclear methods (ASTM D6938) shall be used to verify compaction in consolidation area.

3.05 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 31 23 16, Excavation, and replace with suitable material from the excavation, as specified in Section 31 23 23, Fill and Backfill.

END OF SECTION

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock excavation.

1.02 SUBMITTALS

A. Informational Submittals:

1. Excavation Plan, Detailing:
   a. Methods and sequencing of excavation.
   b. Proposed locations of stockpiled excavated material.
   c. Proposed onsite and offsite spoil disposal sites.
   d. Numbers, types, and sizes of equipment proposed to perform excavations.
   e. Anticipated difficulties and proposed resolutions.
   f. Reclamation of onsite spoil disposal areas.

1.03 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized over-excavation.

1.04 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.05 SEQUENCING AND SCHEDULING

A. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 31 10 00, Site Clearing, prior to excavating.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum.

B. Over-excavation of surficial slag is permitted if slag is present below the lines and grades shown on the Drawings.

1. Contractor shall notify Engineer if slag is present below lines and grades shown.
2. Over-excavation of surficial slag shall occur until all visual evidence of slag is removed.

3.02 SLAG/RESIDUALS EXCAVATION

A. Excavation of slag shall be completed, regardless of the type, nature, or condition of the materials encountered until visual evidence of contamination is gone.

1. Engineer shall be notified if slag is present below lines and grades shown on the Drawings.

B. Remove concrete foundations and obstructions as encountered during excavation. Concrete shall be pulverized and placed in stockpiles as discussed in Article 3.04.

C. Tarry material may be present and mixed with demolition debris in localized areas. Tarry materials which are encountered shall be excavated and analyzed to determine if they are characteristically hazardous.

3.03 COMMON EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

B. Material excavated shall be visually free of slag contamination.

C. Material shall be placed in stockpiles on site to be used either as general site fill or low-permeability cover material.

3.04 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material until material is needed:

1. Surficial slag and pulverized concrete foundations shall be placed on or adjacent to the existing slag stockpile on the northern portion of the site.
2. Unimpacted excavated material shall be stockpiled either in general fill stockpile or clay stockpile as shown on the Drawings.
   a. Clay stockpile material shall be used for the low-permeability cover system. Only clay meeting the performance requirements shall be stockpiled in this area
   b. General fill stockpile material shall be used for general site fill and may consist of clay or other materials as discussed in Section 31 23 23, Fill and Backfill.

B. Post signs indicating proposed use of material stockpiled. Post signs that are readable from all directions of approach to each stockpile. Signs should be clearly worded and readable by equipment operators from their normal seated position.

C. Confine stockpiles to areas shown on the Drawings. Do not obstruct roads or streets.

D. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

F. Excavated tarry material shall be stockpiled in the northwestern portion of the site and appropriately managed separately from the surficial slag while awaiting analytical results.

1. Contractor shall provide plastic sheeting and secondary containment necessary to prevent exposure to, and spread of, tarry material prior to disposal.

3.05 DISPOSAL OF CONSOLIDATION MATERIAL

A. Dispose of excavated materials, which are unsuitable or not needed for fill or backfill, in the consolidation area.

B. Dispose of debris resulting from removal of concrete foundations within the consolidation area.

C. Dispose of tarry material:

1. Nonhazardous tarry materials shall be placed in the consolidation area with surficial slag and pulverized concrete.
2. Characteristically hazardous tarry material shall be appropriately managed onsite as hazardous waste, and sent offsite for disposal at a permitted RCRA Subtitle C disposal facility approved under the Off-Site Rule.

D. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 31 10 00, Site Clearing, for clearing and grubbing debris.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   e. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   f. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
   g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   h. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   i. D6938, Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Engineer.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.

2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

E. Completed Course: A course or layer that is ready for next layer or next phase of Work.

F. Lift: Loose (uncompacted) layer of material.

G. Geosynthetics: Geotextiles, geogrids, or geomembranes.

H. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

I. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

J. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

K. Imported Material: Materials obtained from sources offsite, suitable for specified use.

1.03 SUBMITTALS

A. Action Submittals:

1. Samples: Imported material taken at source.

B. Informational Submittals:

1. Manufacturer’s data sheets for compaction equipment.
2. Certified test results from independent testing agency.

1.04 QUALITY ASSURANCE

A. Notify Engineer when:

1. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
2. Fill material appears to be deviating from Specifications.

1.05 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 31 10 00, Site Clearing; Section 31 23 16, Excavation; and Section 31 23 13, Subgrade Preparation, prior to placing fill or backfill.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.
2. During excavation or production of imported material, test as follows:
   a. Clay Cover: every 1,500 tons.
   b. General Site Fill: every 7,500 tons.
   c. Topsoil: every 7,500 tons.

B. Atterberg Limits Tests:

1. As necessary to locate acceptable sources of imported material.
2. During excavation or production of imported material, test as follows:
   a. Clay Cover: every 1,500 tons.
   b. General Site Fill: every 7,500 tons.
   c. Topsoil: every 7,500 tons.

C. Proctor Tests:

1. As necessary to locate acceptable sources of imported material.
2. During excavation or production of imported material, test as follows:
   a. Clay Cover: every 1,500 tons.
   b. General Site Fill: every 7,500 tons.

D. Samples: Collected in accordance with ASTM D75:

1. During excavation or production of imported material, provide Samples as follows:
   a. Clay Cover: every 1,500 tons.

b. General Site Fill: every 7,500 tons.
c. Topsoil: every 7,500 tons.
2. Clearly mark to show source of material and intended use.

2.02 CONSOLIDATION MATERIAL

A. Material intended for the consolidation area:

1. Excavated material from on-site consisting of surficial slag and affected soil.
2. Excavated material from off-site residential properties consisting of soil potentially mixed with slag.

2.03 CLAY COVER MATERIAL

A. On-site material naturally occurring below surficial slag excavated to create the consolidation area.

B. Conforming to the following properties:

1. Soil material consisting of generally clay soils with an USCS classification (ASTM D2487) of SC, CL, CL-ML, CH or otherwise approved by the Owner or Owner’s Representative.
2. Maximum particle size of 1-1/2 inches. Minimum of 20 percent passing the #200 sieve, by weight.

2.04 GENERAL SITE FILL

A. Free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

2.05 TOPSOIL

A. As specified in Section 32 91 13, Soil Preparation.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

D. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

3.02 FILL

A. Consolidation Material:

1. Maximum 8-inch thick lifts.
2. Place and compact across full width of consolidation area.
3. Compact to minimum 98 percent relative compaction as determined in accordance with ASTM D698.

B. Clay Cover

1. Maximum 6-inch thick lifts.
2. Place and compact across full width of cover.
3. Compact to minimum 98 percent relative compaction as determined in accordance with ASTM D698.

C. General Site Fill:

1. Allow for 12-inch thickness of topsoil where required.
2. Maximum 12-inch thick lifts.
3. Compact to minimum 98 percent relative compaction as determined in accordance with ASTM D698.
4. Dress completed fill with allowance for topsoil, crest surfacing, and slope protection, where applicable.

3.03 SITE TESTING

A. Gradation, Atterberg Limits, and Proctor Tests:

1. One sample from each 1,500 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.

3. Remove material placed in Work that does not meet Specification requirements.

B. Permeability Tests:

1. One sample from each 3,000 tons of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. Shelby tubes shall be taken from completed sections of cover and tested by ASTM D5084.
3. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
4. Remove material placed in Work that does not meet Specification requirements.

C. In-Place Density Tests: In accordance with ASTM D6938. During placement of materials, test as follows:

1. Consolidation Material: 1 test per 200 foot grid, each lift.
2. Clay Cover: 1 test per 100 foot grid, each lift.

3.04 REPLACING OVER-EXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by Engineer as follows:

1. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.

END OF SECTION

SECTION 32 91 13
SOIL PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
    a. C33/C33M, Standard Specification for Concrete Aggregates.
    b. C602, Standard Specification for Agricultural Liming Materials.
    c. D2974, Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
    d. D5268, Standard Specification for Topsoil Used for Landscaping Purposes.

1.02 SUBMITTALS

A. Action Submittals:

1. Samples: Representative of stockpiled or imported topsoil.

B. Informational Submittals:

1. Certified Topsoil Analysis Reports:
    a. Indicate quantities of materials necessary to bring imported topsoil into compliance with textural/gradation requirements.
    b. Indicate quantity of lime, quantity and analysis of fertilizer, and quantity and type of soil additive.

1.03 SEQUENCING AND SCHEDULING

A. Perform Work specified in Section 31 10 00, Site Clearing, Section 31 23 16, Excavation, and Section 31 23 23, Fill and Backfill prior to performing Work specified under this section.

PART 2 PRODUCTS

2.01 TOPSOIL

A. General: Natural, friable, sandy loam, obtained from well-drained areas, free from objects larger than 1-1/2 inches maximum dimension, and free of subsoil, roots, grass, other foreign matter, hazardous or toxic substances, and deleterious material that may be harmful to plant growth or may hinder grading, planting, or maintenance.

B. Composition: In general accordance with ASTM D5268:

1. Gravel-Sized Fraction: Maximum 5 percent by weight retained on a No. 10 sieve.
2. Sand-Sized Fraction: Minimum 20 to 60 percent passing No. 10 sieve.
3. Silt and Clay-Sized Fraction: Minimum 35 to 70 percent.

C. Organic Matter: Minimum 1.5 percent by dry weight as determined in accordance with ASTM D2974.

D. pH: Range 5.0 to 7.0.

E. Textural Amendments: Amend as necessary to conform to required composition by incorporating sand, peat, manure, or sawdust.

F. Source: Import topsoil if onsite material is insufficient in quantity.

2.02 LIME

A. Composition: Ground limestone with not less than 85 percent total carbonates, ASTM C602.

B. Gradation:

1. Minimum 50 percent passing No. 100 sieve.
2. Minimum 90 percent passing No. 20 sieve.
3. Coarser material acceptable provided rates of application are increased proportionately on basis of quantities passing No. 100 sieve.

2.03 SOIL ADDITIVES

A. Sawdust or Ground Bark:

1. Nontoxic, of uniform texture, and subject to slow decomposition when mixed with soil.
2. Nitrogen-treated, or if untreated mix with minimum 0.15 pound of ammonium nitrate or 0.25 pound of ammonium sulfate per cubic foot of loose material.

B. Peat:

1. Composition: Natural residue formed by decomposition of reeds, sedges, or mosses in a freshwater environment, free from lumps, roots, and stones.
    a. Organic Matter: Not less than 90 percent on a dry weight basis as determined by ASTM D2974.

b. Moisture Content: Maximum 65 percent by weight at time of delivery.

C. Fertilizer:

1. Natural:
   a. Manure:
      1) Well-rotted, stable or cattle manure, free from weed seed and refuse.
      2) Maximum 50 percent sawdust or shavings by volume.
      3) Age: Minimum 4 months; maximum 2 years.
2. Commercial:
   a. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose.
   b. Contain the following minimum percentage of plant food by weight:
      1) Summer Mix:
         a) Nitrogen: 20 percent.
         b) Phosphoric Acid: 10 percent.
         c) Potash: 10 percent.
      2) Winter Mix:
         a) Nitrogen: 16 percent.
         b) Phosphoric Acid: 8 percent.
         c) Potash: 0 percent.

D. Sand: Fine Aggregate: Clean, coarse, well-graded, ASTM C33/C33M.

2.04 SOIL STERILANT

A. Granular Calcium Cyanamide: Herbicide, manufactured by American Cyanamide Co.

2.05 SOURCE QUALITY CONTROL

A. Topsoil Analysis/Testing: Performed by county or state soil testing service or approved certified independent testing laboratory.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

A. Scarify subgrade to minimum depth of 6 inches where topsoil is to be placed.

B. Remove stones over 2-1/2 inches in any dimension, sticks, roots, rubbish, and other extraneous material.

C. Limit preparation to areas which will receive topsoil within 2 days after preparation.

3.02 TOPSOIL PLACEMENT

A. Do not place topsoil when subsoil or topsoil is frozen, excessively wet, or otherwise detrimental to the Work.

B. Mix soil amendments, lime, and other soil additives, identified in analysis reports with topsoil before placement or spread on topsoil surface and mix thoroughly into entire depth of topsoil before planting or seeding. Delay mixing of fertilizer if planting or seeding will not occur within 3 days.

C. Place one-half of the total depth of topsoil and work into top 4 inches of subgrade soil to create a transition layer. Place remainder of topsoil to depth as shown where seeding and planting are scheduled.

D. Uniformly distribute to within 1/2 inch of final grades. Fine grade topsoil eliminating rough or low areas and maintaining levels, profiles, and contours of subgrade.

E. Remove stones exceeding 1-1/2-inch diameter, roots, sticks, debris, and foreign matter during and after topsoil placement.

F. Remove surplus subsoil and topsoil from Site. Grade stockpile area as necessary and place in condition acceptable for planting or seeding.

END OF SECTION

SECTION 32 92 00
TURF AND GRASSES

PART 1 GENERAL

1.01 DEFINITIONS

A. Maintenance Period: Begin maintenance immediately after each area is planted (seed, sod, or sprig) and continue for a period of 8 weeks after all planting under this section is completed.

B. Satisfactory Stand: Grass or section of grass of 10,000 square feet or larger that has:

1. No bare spots larger than 3 square feet.
2. Not more than 10 percent of total area with bare spots larger than 1 square foot.
3. Not more than 15 percent of total area with bare spots larger than 6 square inches.

1.02 SUBMITTALS

A. Action Submittals: Product labels/data sheets.

B. Informational Submittals:

1. Seed: Certification of seed analysis, germination rate, and inoculation:
   a. Certify that each lot of seed has been tested by a testing laboratory certified in seed testing, within 6 months of date of delivery. Include with certification:
      1) Name and address of laboratory.
      2) Date of test.
      3) Lot number for each seed specified.
      4) Test Results: (i) name, (ii) percentages of purity and of germination, and (iii) weed content for each kind of seed furnished.
   b. Mixtures: Proportions of each kind of seed.
2. Seed Inoculant Certification: Bacteria prepared specifically for legume species to be inoculated.
3. Description of required maintenance activities and activity frequency.

1.03 DELIVERY, STORAGE, AND PROTECTION

A. Seed:

1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
2. Keep dry during storage.

B. Hydroseeding Mulch: Mark package of wood fiber mulch to show air dry weight.

1.04 WEATHER RESTRICTIONS

A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.05 SEQUENCING AND SCHEDULING

A. Prepare topsoil as specified in Section 32 91 13, Soil Preparation, before starting Work of this section.

B. Complete Work under this section within 3 days following completion of soil preparation.

C. Notify Engineer at least 3 days in advance of:

1. Each material delivery.
2. Start of planting activity.

D. Planting Season: Those times of year that are normal for such Work as determined by accepted local practice.

1.06 MAINTENANCE SERVICE

A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.
2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.
3. Mulch: Replace wherever and whenever washed or blown away.
4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.

5. Reseed unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced.
6. Reseed/replant during next planting season if scheduled end of maintenance period falls after September 15.
7. Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

PART 2 PRODUCTS

2.01 FERTILIZER

A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.

B. Application Rates: Determined by soil analysis results.

C. Mix:

1. Nitrogen: 10 percent.
2. Phosphoric Acid: 10 percent.
3. Potash: 10 percent.
4. Bonemeal: Commercial, raw, finely ground, with minimum analysis of 4 percent nitrogen and 20 percent phosphoric acid.
5. Superphosphate: Soluble mixture of phosphate obtained from treated mineral phosphates with minimum analysis of 20 percent available phosphoric acid.

D. Top Dress Type: As recommended by local authority.

2.02 SEED

A. Fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.

B. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer’s instructions.

C. Summer Seed Mix: As recommended by local authority.

D. Winter Protective Seed: Annual ryegrass.

2.03 STRAW MULCH

A. Threshed straw of oats, wheat, barley, or rye, free from (i) seed of noxious weeds or (ii) clean salt hay.

2.04 HYDROSEEDING MULCH

A. Wood Cellulose Fiber Mulch:

1. Specially processed wood fiber containing no growth or germination inhibiting factors.
2. Dyed a suitable color to facilitate inspection of material placement.
3. Manufactured such that after addition and agitation in slurry tanks with water, the material fibers will become uniformly suspended to form homogenous slurry.
4. When hydraulically sprayed on ground, material will allow absorption and percolation of moisture.

2.05 NETTING

A. Jute:

1. Heavy-duty, twisted, weighing 1 pound per square yard.
2. Openings Between Strands: Approximately 1 inch square.

B. Plastic:

1. Extruded Polypropylene: 20 mils.
2. Opening Between Strands: 1 inch by 2 inch.

C. Matting:

1. Excelsior mat or straw blanket; staples as recommended by matting manufacturer.
2. Manufacturers and Products:
   a. Akzo Industries, Ashville, NC; Curlex mat.
   b. North American Green, Evansville, IN; S150 blanket.

2.06 TACKIFIER

A. Derived from natural organic plant sources containing no growth or germination-inhibiting materials.

1. Capable of hydrating in water, and to readily blend with other slurry materials.

2. Wood Cellulose Fiber: Add as tracer, at rate of 150 pounds per acre.
3. Manufacturers and Products:
    a. Chevron Asphalt Co.; CSS 1.
    b. Terra; Tack AR.
    c. J Tack; Reclamare.

2.07 WEED BARRIER

A. 6 mils (0.006 inch) black polyethylene sheet.

PART 3 EXECUTION

3.01 PREPARATION

A. Grade areas to smooth, even surface with loose, uniformly fine texture.

1. Roll and rake, remove ridges, fill depressions to meet finish grades.
2. Limit such Work to areas to be planted within immediate future.
3. Remove debris, and stones larger than 1-1/2-inch diameter, and other objects that may interfere with planting and maintenance operations.

B. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.

C. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

3.02 FERTILIZER

A. Apply evenly over area in accordance with manufacturer’s instructions. Mix into top 2 inches of topsoil, when applied by broad cast method.

B. Application Rate: 23 pounds per 1,000 square feet (1,000 pounds per acre).

3.03 SEEDING

A. Start within 2 days of preparation completion.

B. Hydroseed slopes steeper than 3H:1V. Flatter slopes may be mechanically seeded.

C. Mechanical: Broadcast seed in two different directions, compact seeded area with cultipacter or roller.

1. Sow seed at uniform rate of 50 pounds per acre.

2. Use Brillion type seeder.
3. Broadcasting will be allowed only in areas too small to use Brillion type seeder. Where seed is broadcast, increase seeding rate 20 percent.
4. Roll with ring roller to cover seed, and water with fine spray.

D. Hydroseeding:

1. Application Rate: 50 pounds per acre.
2. Apply on moist soil, only after free surface water has drained away.
3. Prevent drift and displacement of mixture into other areas.
4. Upon application, allow absorption and percolation of moisture into ground.
5. Mixtures: Seed and fertilizer may be mixed together, apply within 30 minutes of mixing to prevent fertilizer from burning seed.

E. Cover Crop Seeding: Apply seed at rate of 120 pounds per acre to areas that are bare or incomplete after September 15.

F. Mulching: Apply uniform cover of straw mulch at a rate of 2 tons per acre.

G. Netting: Immediately after mulching, place over mulched areas with slopes steeper than 3H:1V, in accordance with manufacturer's instructions. Locate strips parallel to slope and completely cover seeded areas.

H. Tackifier: Apply over mulched areas with slopes steeper than 4:1 at rate of 5 gallons per 1,000 square feet in accordance with the manufacturers recommended requirements.

I. Water: Apply with fine spray after mulching to saturate top 4 inches of soil.

3.04 FIELD QUALITY CONTROL

A. 8 weeks after seeding is complete and on written notice from Contractor, Engineer will, within 15 days of receipt, determine if a satisfactory stand has been established.

B. If a satisfactory stand has not been established, Engineer will make another determination after written notice from Contractor following the next growing season.

3.05 PROTECTION

A. Protect from pedestrian traffic by erecting temporary fence around each newly seeded area.

END OF SECTION

Appendix D
Construction Quality Assurance Plan

CONSTRUCTION QUALITY ASSURANCE/
QUALITY CONTROL PLAN

Old American Zinc Superfund Site
Fairmont City
St. Clair County, Illinois

Preliminary Remedial Design
WA No. 224-RDRD-B5A1 / Contract No. EP-S5-06-01

Prepared for

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

May 2018

ch2m

Contents

Appendix

Figure

Tables

Acronyms and Abbreviations

ASTM	ASTM International
CH2M	CH2M HILL, Inc.
EPA	U.S. Environmental Protection Agency
HASP	health and safety plan
KA	contract administrator
OAZ	Old American Zinc
QA	quality assurance
QC	quality control
QAP	Construction Quality Assurance/Quality Control Plan
RFI	Request for Information

SECTION 1

Introduction

1.1 Purpose and Objective

This Construction Quality Assurance/Quality Control Plan (QAP) establishes project control procedures and presents procedures used to ensure that the highest-quality product and services are delivered to the owner. It establishes guidelines for reviewing procedures and deliverables, identifying and resolving potential issues prior to impacting project objectives, and determining the most efficient ways to correct these issues. This QAP focuses on the construction of an onsite consolidation cell at the Old American Zinc (OAZ) Superfund Site in Fairmont City, Illinois, and is prepared in accordance with U.S. Environmental Protection Agency (EPA) Work Assignment No. 224-RDRD-B5A1, under Contract No. EP-S5-06-01. These procedures and processes are derived from the CH2M HILL (CH2M) Construction Quality Management Manual and CH2M's core quality standards.

The purpose of this QAP is to establish and implement the following quality assurance (QA)/quality control (QC) elements for the project:

- QC organization and responsibilities
- Training and qualification of project personnel, including subcontractors
- Inspections
- Monitoring tests and observations
- Calibration and maintenance
- Data quality
- Submittal review and approval
- QC documentation
- Change control
- Noncompliance and corrective actions
- Document and technical reviews
- Project communications

The strategy of the QAP is to use a proactive approach to identifying engineering quality in the critical work elements of the project prior to implementation and during construction. The contractor will use internal experts to ensure critical work elements of the project are identified and the proper QC procedures are established. The contractor will also consult with the project stakeholders such as EPA and the oversight contractor to verify that all requirements and expectations for the project are met. The contractor will use communication vehicles such as weekly or monthly meetings, telephone or video conferences, and e-mail to discuss and resolve issues related to the successful implementation of the project.

The overall project objective is to construct an onsite consolidation cell in a cost-effective and environmentally safe manner. The use of "CH2M" in this document means CH2M and its subcontractors.

1.2 Definable Features of Work

A definable feature of work is a task that is separate and distinct from other tasks and has separate control requirements. The QAP outlines the quality control requirements applicable to perform the definable feature of work activities for this project, which include the following:

- Project management/site management/health and safety
- Mobilization/site preparation/site controls/demobilization

- Site clearing and grubbing
- Subgrade Preparation
- Low-permeability Soil Placement
- Vegetative Cover Soil Placement
- Seeding and Site Restoration
- Universal Waste Abatement
- Material Management
- Transportation and Disposal
- Demobilization and construction completion reporting.

These activities will be performed in accordance with the respective subcontractor's statement of work, project planning documents and the project management work plan. All submittals will have been reviewed/approved by CH2M before mobilization and will be onsite at all times for reference.

SECTION 2

Organization and Responsibilities

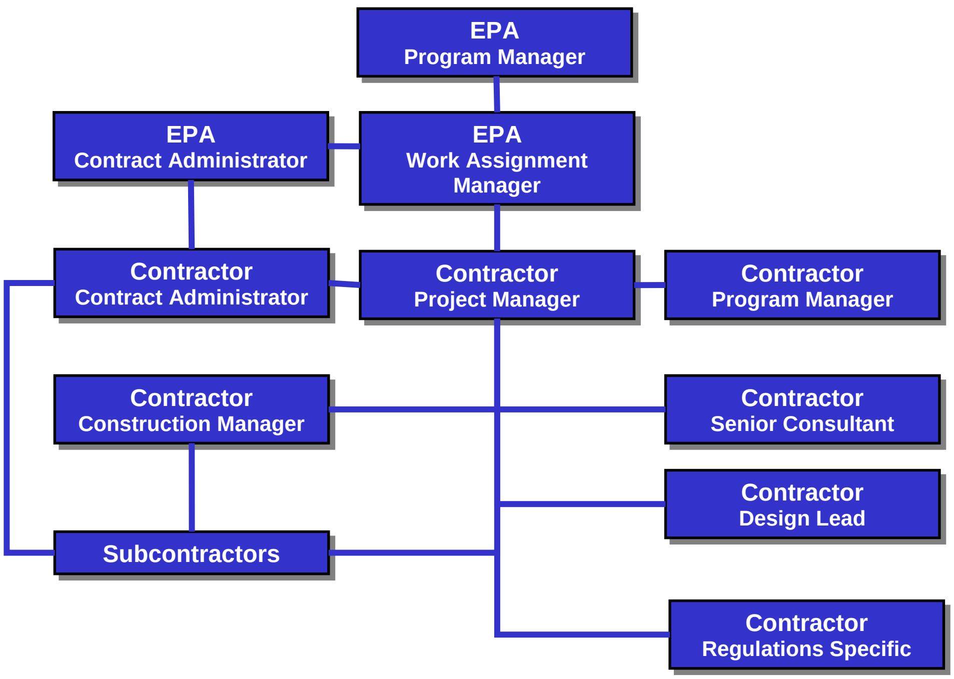
The responsibility for implementation and enforcement of the QAP is assigned to the project manager. The project quality manager will assume execution responsibility of this plan. The program QA/QC manager is responsible for QA and verification of the effectiveness of the program and project quality control.

2.1 Responsibility and Authority

The following subsections outline the responsibilities of the key members in the project organization.

Figure 2-1 shows the project organization chart and identifies lines of communications between project parties.

Figure 2-1. Organization Chart
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois



2.1.1 Owner

EPA is the owner of the project. The owner is responsible for the overall design, construction, and closure of the site. The owner has the authority to complete the following actions:

- Select and dismiss organizations charged with design, QA, and construction activities.
- Accept, reject, or modify design plans and specifications.
- Accept, reject, or modify the QAP and reports.
- Accept or reject the materials and workmanship of the construction subcontractors.

2.1.2 Project Manager

The project manager is responsible for the overall execution of the project. The project manager will interact and communicate directly with EPA and the project team regularly throughout the duration of the remedial design/remedial action to ensure that the contract and performance objectives are met. The project manager ultimately is accountable for the work activities undertaken on the project. As such, the project manager will provide the managerial administrative skills to ensure that resource allocations, planning, execution, and reporting meet expectations and contract requirements. Specifically, the project manager is responsible for the following:

- Organize project staff and assign responsibilities.
- Understand the contract and scope of work.
- Communicate to the project staff and subcontractors regarding owner requirements and QA/QC practices.
- Identify and provide documentation, and notify the owner and project team of changes in the scope of work, project documentation, and activities.
- Ensure submittals are received by subcontractors and are reviewed by appropriate personnel
- Supervise preparation and approval of project-specific procedures, work plans, and QA project plans.
- Approve project design bases, design parameters, drawings, and reports.
- Approve project construction methodologies.
- Disseminate project-related information from the owner such as design bases, input parameters, and drawings.
- Serve as liaison for communications with the owner and subcontractors.
- Serve as liaison between the project staff and other internal and external groups.
- Determine whether drawings require independent review.
- Investigate nonconformance and implementation of corrective actions.
- Evaluate the effect of nonconformance on the project for reporting such items to the owner, and provide appropriate documentation for reporting.
- Determine that changes, revisions, and rework items are subject to the same QC requirements as the original work.
- Serve as final reviewer prior to release of project information.
- Approve and sign outgoing correspondence.
- Coordinate and attend the project kickoff meeting, preconstruction meeting, and regular project status meetings.
- Attend partnering meetings and public/regulatory meetings.

This list is not meant to be all-inclusive, and the project manager may assign some of these responsibilities to the construction manager, who will remain onsite throughout the project field activities.

2.1.3 Construction Manager

The construction manager is responsible to the project manager for efficiently applying the resources of the project team to execute construction. In addition, the construction manager is responsible for the technical, personnel, construction methodology, quality, safety, and local client interface details of the project and the project team while mobilized to the site. The construction manager will assist the project manager to ensure that sufficient resource allocations to maintain project schedule and budget are maintained and provide daily feedback to the project manager on project progress, issues requiring resolution, and other project specific issues, as required.

The quality-related responsibilities of the construction manager and site superintendent include, but are not limited to, the following:

- Notify the project manager if the project cannot be completed with regard to quality, schedule, or cost.
- Provide oversight and control of subcontractor services.
- Organize and set up temporary facilities and storage yards for the entire project.
- Ensure that the site is constructed in accordance with the construction drawings and technical specifications.
- Monitor the construction productivity in relation to construction schedules and technical specifications.
- Serve as liaison for communications with project staff and subcontractors, as well as with the onsite client representatives.
- Advise the project manager and owner of changed conditions, nonconformance, and requirements for field changes.
- Coordinate daily health and safety tailgate meetings.
- Attend kickoff, preconstruction, and progress status meetings.
- Support and enforce health and safety requirements throughout the entire project.
- Maintain field logs and daily reporting, including relevant photographs and all pertinent events.
- Review and recommend action on value engineering change proposals.
- Review and recommend changes.
- Prepare and submit Requests for Information (RFIs) and route them to the project manager and technical consultant for review and approval.
- Advise on need and cost of proposed change orders.
- Assist in prevention and resolution of subcontractor claims.
- Recommend approval or rejection of construction schedules.
- Ensure subcontractors are set up for success in schedule and compliance.
- Continuously monitor work progress, quality, safety, and adherence to authorized work scopes, budgets, and schedules.
- Interface daily with the subcontractors.

2.1.4 Project Quality Control Manager

The project QC manager is responsible for the execution of this project QAP and communicates the onsite QC program policies, objectives and procedures to the project personnel and subcontractors during project meetings and informal discussions. Onsite technical personnel, who may include QC inspectors, engineers, chemists, hydrogeologists, and scientists, will assist the QC manager in monitoring, controlling, and documenting the quality of the onsite construction and survey activities. Documentation-related project QC, including analytical test results, inspections, material test results, and audits will be reviewed or prepared by the project QC manager. The project QC manager responsibilities include, but are not limited to, the following:

- Construction QC inspections and testing of materials and workmanship
- Control testing
- Document control
- Reviewing submittals
- Administering RFIs
- Completion inspection
- Records
- Audits and surveillance

The project QC manager will also coordinate with and assist the client representative in the performance of QA/QC audits and inspections.

The project QC manager or a representation will have the authority to stop project work because of nonconformance with the QAP. Onsite personnel will be encouraged to discuss concerns with the project QC manager and supporting technical personnel. If the project QC manager is informed of and/or detects an incident of project nonconformance, the project QC manager will perform an initial investigation, evaluate the course of corrective action required, document the incident, and report the incident to the project manager. If the project QC manager is not satisfied with the resolution of the nonconformance, the project QC manager will contact the program QA/QC manager.

2.1.5 Design Manager

The design manager's primary responsibility is to design the landfill to fulfill the requirements of the Record of Decision. Design-related activities may not end until construction is complete. The design manager is responsible for the following activities during the project execution:

- Review and approve construction plans (design drawings) and specifications.
- Clarify or interpret requirements of the plans and specifications.
- Review requests for design changes during construction, RFIs, and provide response(s) when necessary.
- Prepare design changes to account for unexpected site conditions or changes in construction and operation methodology.
- Review and approve shop drawings and submittals from subcontractors and vendors.
- Interact with construction team on problem solving and solutions.
- Observe construction of critical design features.
- Provide overall input regarding the impact of scope changes on other portions of the work.
- Modify or change the final plans for as-built record drawings.

2.1.6 Waste Management Coordinator/Regulatory Management

The waste management coordinator/regulatory manager will provide regulatory compliance and waste management coordination and expertise. The roles and responsibility associated with this position will include preparing and collecting all required waste management and tracking documentation, including waste manifests, bills of lading, weight tickets, and hazardous waste labels.

2.1.7 Health and Safety Manager

The health and safety manager for the project is responsible for the health and safety plan (HASP) to be supported by all site employees. Health and safety are team functions, and not only is compliance required, but excellence is expected.

2.1.8 Quality Assurance/Quality Control Manager

The quality manager and the onsite QA/QC manager are responsible for implementing the QA/QC plan. Quality is a team function, and not only is compliance required on all phases of the project, but excellence is expected. The onsite QA/QC manager will assume the responsibility to coordinate and track all waste shipments with the subcontractors and the disposal and recycling facilities.

2.1.9 Document Manager

The document manager will provide part-time assistance to the project and provide logistics support. This effort includes implementing document controls, disseminating communications, in-house document production (editing, graphics, word processing, and reproduction) and coordinating services related to printing, binding, and distributing the final reports in both hard copy and on CD and archiving the project deliverables for easy retrieval and electronic filing.

2.1.10 Senior Consultants

Senior consultants are responsible for overseeing the planning and review of the technical and operational work performed. They will work closely with the project manager and design project manager to ensure technical excellence and compliance.

2.1.11 Project Contract Administrator

The Contract Administrator (KA) for this project will assist the team with contractual issues. The KA is responsible for ensuring procurement is conducted in accordance with the protocol for subcontracting. The KA will assist in evaluating subcontractors/vendors payment applications for processing and will also be involved with any potential change order management of subcontractor(s)/vendors. In addition, the KA will ensure that the potential subcontractor's/vendor's proposals contain appropriate rates and have adequate documentation. Subcontracting for this project is on an extremely fast-track schedule.

2.1.12 Project Accountant

The project accountant will assist in matters concerning budgets, invoices, percent completes, estimates at complete, and individual project financial report formats. The project accountant is also responsible for ensuring that all travel expenses are in accordance with the project budget.

2.1.13 Subcontractors

It is expected the contractor will subcontract the following services during the execution of this project:

- Surveying
- Clearing, excavation, backfilling, planting of vegetation, and site restoration
- Laboratory analyses (geotechnical)
- Special inspection, observation, and testing (geotechnical)

The contractor assumes the overall responsibility for conformance to the quality requirements for the subcontracted items and services. Each subcontractor will be responsible for planning, managing, and effectively executing the project activities in accordance with the appropriate documentation.

Subcontractors are responsible directly to the construction manager for completion of the portion of project activities assigned, and to the project QC manager for QAP activities. Subcontractors will verify that construction and materials used to perform the activities herein comply with the requirements of the contract plans and specifications. Subcontractors include those organizations supplying quality-related items or services to the project.

2.2 Resolution of Conflicts

If the QC team detects a nonconforming item, the QC manager will investigate it. If the QC manager determines that additional corrective action is warranted, the QC manager will document and review the issue with the site construction manager and project manager. The QC manager has the authority to stop work on any nonconforming activity. If satisfactory resolution cannot be achieved between the QC manager and the project manager, it will be elevated to the program QA/QC manager, and if necessary, to the owner.

SECTION 3

Training and Qualifications

During project team chartering, the project manager will determine the necessary staff qualifications and will review the staff training documentation (resumes, professional engineer registration, health and safety, and any other certifications) needed to complete this project. The project manager will be responsible for ensuring that each individual is qualified and has completed any necessary training for his or her assigned tasks. The project manager will also be responsible for determining and documenting when formal qualification or certification is required. The project manager will ensure that training is completed before task initiation and the appropriate certification documents are obtained and retained as quality records in the project files.

SECTION 4

Communications and Meetings

Table 4-1 shows meetings that will be held throughout the execution of the project to ensure regular communication between the contractor and the owner, among project team members, and between the contractor and the subcontractors.

Table 4-1. Project Meetings
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

		Contractor				
Meeting	**EPA**	**Project Manager**	**Construction Manager**	**Subcontractors**	**Project Staff**	**Schedule**
Kickoff meeting	X	X	X	Optional		Before mobilization
Public Meeting	X	X				Before mobilization
Preconstruction Meeting	Optional	X	X	X	X	Before mobilization
Public/Regulatory Meeting	X	X	X			If needed
Tailgate Meetings	Optional	Optional	X	X	X	Before start of work each day onsite
Project Status Meeting	Optional	X	X	X	X	Weekly (can be by teleconference)

X = Required attendance. Optional attendance is at the discretion of the project manager or EPA representative, depending on the relevance of the meeting.

4.1 Kickoff Meeting

Before the site work begins, the project team will meet with the owner and stakeholders to develop a mutual understanding of the project details, including health and safety issues, communication procedures, evacuation/emergency procedures, scheduling work, security procedures, submittal reviewer/approvers, inspectors/approvers of major milestones work performed, permits required, forms to be used, administration of onsite and offsite work, signature authorities for changes and waste documentation, schedule, and method for transmitting submittals. Minutes of the meeting will be prepared by the project manager and signed by the contractor's representative, the owner's designated representatives, and the stakeholders (facility personnel, fire marshal, regulatory agencies, etc.). Meeting minutes will be distributed to the parties involved in the meeting and placed in the project files. This meeting may be held in conjunction with other meetings (for example, the preconstruction meeting).

4.2 Preconstruction Meeting

A preconstruction meeting with the project subcontractors is required for discussion of the administrative procedures for the project. During the conference, ground rules and understandings are established between the contractor and its subcontractors. This meeting is also an opportunity to emphasize the importance of health and safety, quality, and regulatory compliance to the subcontractors.

The preconstruction meeting is held between the project team and subcontractors' representatives. The owner may also be present, or a separate preconstruction meeting with the owner may be conducted after the contractor has met formally with its subcontractors. The purpose of this meeting is to ensure that all parties involved in the project understand and agree on the following:

- Project scope
- Work approach, construction means, and methods
- Roles and responsibilities
- Designation of responsible personnel
- Schedule
- Submittal requirements
- Reporting and documentation requirements
- Use of the site for storage, vehicle parking, access routes, and other site requirements
- Change management processes and procedures
- Communication procedures
- Client requirements
- Health and safety requirements
- Progress schedules
- Permitting and regulatory issues
- Quality issues and reporting
- Security and housekeeping procedures
- Procedures for maintaining record documents
- Waste handling and documentation
- Testing and inspection schedule and reporting

Minutes of the meeting will be prepared by the project manager or construction manager and signed by both the contractor’s and subcontractors’ representatives. Copies of the minutes will be distributed to the parties from the meeting and placed in the project files.

4.3 Public/Regulatory Meetings

The contractor will participate in any public/regulatory meetings to present the proposed plan/Record of Decision for the project as needed.

4.4 Tailgate Meetings

Daily tailgate meetings are held with all project personnel in attendance to review safety hazards posed and required health and safety procedures and job hazard analyses applicable to each day’s activities. At the start of each day, the construction manager discusses the proposed work tasks for that day, with input from the work crew, to ensure that site workers are familiar with the proposed activities. The day’s tasks, personnel, tools, and equipment that will be used to perform these tasks are reviewed, along with the hazards posed, associated mitigations, and required health and safety procedures. These daily tailgate meetings promote worker participation in the hazard recognition and control process, while reinforcing the task-specific hazard and required health and safety procedures with the crew each day.

4.5 Project Status Meetings

After the start of site work and throughout project execution, the project team will conduct project status meetings (sometimes referred to as a quality meeting) at least weekly during active construction. The owner’s representatives and stakeholders may attend these meetings. The main purpose of the meetings is to track progress to date and to discuss progress planned over the next 2 or 3 weeks (look-ahead scheduling) in order to resolve project issues before they may occur.

At a minimum, the following will be accomplished at each meeting:

- Review the minutes of the previous meeting.
- Discuss health and safety issues.
- Review the schedule:
  - Work or testing accomplished since last meeting
  - Rework items identified since last meeting
  - Rework items completed since last meeting
  - Schedule delays and long lead time items
  - Critical milestones
- Review the status of submittals:
  - Submittals reviewed and approved since last meeting
  - Submittals required in the near future
  - RFI resolutions
- Review the work to be accomplished in the next 2 weeks and documentation required:
  - Establish completion dates for rework items
  - Inspections required
  - Testing required
  - Status of offsite work or testing
  - Documentation required
- Discuss health and safety issues (i.e., near-misses and incidents).
- Resolve QC and production problems.
- Address items that may require revising the project plans:
  - Changes in procedures
  - Changes in design/engineering drawings and/or specifications
- Address field change requests, design change notices, RFIs.

Meetings will be recorded in project status meeting minutes, prepared by the construction manager or QC manager. The meetings may be held in conjunction with other meetings (such as tailgate safety meetings, progress meetings, planning meetings, etc.). Meeting minutes will be provided to the project manager and placed in the project files in addition to being forwarded to protect team members.

Inspection Activities

The project QC manager is responsible for performing inspection activities and documenting compliance with project requirements.

5.1 Inspections

The QC manager's responsibilities include inspection of all equipment and materials prior to being accepted and installed at the site, and daily review of all construction activities required to complete the scope of work as identified in the final approved project plans. Table 5-1 shows inspection activities for the project that will be performed by the QC manager.

Table 5-1. Project Inspection Activities by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Inspection
Mobilization	• Ensure that preconstruction and construction QC submittals are reviewed and approved. • Review qualifications of personnel to ensure they meet the specification and work plan requirements (certifications, licenses, etc.). • Ensure that the following are onsite before any work begins: HASP, activity hazard analyses, personnel training certificates, subcontractor Statements of Work and compensation schedule, emergency route to hospital, and Dig Safe Reference number. • Ensure materials and equipment are received in working order and in compliance with work plans and specifications. • Ensure materials and equipment are stored in accordance with work plans and specifications. • Ensure adequate permits. • Maintain construction schedule. • Design traffic routes for compliance with work plan. • Catch basins grates are covered with filter fabric. • Enable site security measures for compliance with work plan. • Review layout drawings for completeness and accuracy. • Connection of temporary facilities. • Review staging areas for storage of wastes, recyclable materials, heavy equipment, and storage containers. • Inspect decontamination areas to ensure they meet the requirements of the plans. • Verify equipment condition is acceptable and that features (such as backup alarms) function properly. • Verify personnel are properly trained and certified to perform the work. • Ensure personnel have proper personal protective equipment to perform the work. • Ensure work zones and signage are properly established. • Ensure proper material safety data sheets are available onsite. • Ensure break and rest areas are established. • Ensure utilities are properly protected.

Table 5-1. Project Inspection Activities by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Inspection
Clearing and Grubbing	• Ensure all topsoil and vegetative matter are removed from existing ground surface. • Perform clearing and grubbing limits/layout. • Ensure utility clearance. • Perform clearing separate from grubbing when required. • Dispose of cleared and grubbed materials. • Ensure limited or no disturbance of adjacent areas. • Visually characterize site for types of vegetative cover, debris, and obstructions.
Erosion Control	• Receive and approve submittals. • Confirm materials meet specifications and plans. • Maintain site layout and drawings on hand. • Ensure control device locations are properly laid out and marked prior to installation. • Ensure control devices are properly installed. • Ensure control devices are adequate to minimize run-on and runoff. • Note and repair damaged areas in a timely manner. • Ensure control devices are regularly maintained, cleaned, and silt removed.
Surveying	• Provide surveyor qualifications/licenses. • Establish temporary control points. • Verify existing monuments. • Protect monuments and control points. • Ensure instrument calibration and accuracy. • Survey horizontal and vertical control. • Survey tolerances (horizontal and vertical angles). • Reference applicable plane coordinates and vertical datum. • Provide surveyor notes that are legible, accurate, and complete. • Provide electronic and hard copy data deliverables. • Ensure stake alignment and spacing intervals • Ensure stake flagging/marking. • Provide as-builts, drawings, and maps.
Material Receiving	• Visually inspect material upon arrival to the site for damages. • Check type and quantities of arrived materials against purchase order, shipping label, and confirmation lists. Note any incorrect quantities, incorrect type and models, and missing items. • Visually inspect the quality of material if the material has manufacturer-specified grade or quality rating. • Inspect and verify the received materials. Ensure they were built or manufactured in accordance to manufacturer specifications or data.

Table 5-1. Project Inspection Activities by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Inspection
	• Document and report material/product deficiencies and/or irregularities immediately to QC manager and project manager. • Inspect the temporary storage area provided by the construction subcontractor for material storage to ensure the materials are stored in a safe, secure, and manufacturer-specified environment prior to usage in construction.
Earthwork	• Provide layout drawings. • Ensure Unified Soil Classification System classification (soil/aggregate). • Perform laboratory compaction characteristics. • Perform sieve analysis. • Perform Atterberg Limits (liquid limit, plastic limit, Plasticity Index). • Report general fill condition (homogenous, no large debris or root matter). • Ensure imported fill material chemically acceptable or certified as clean fill. • Provide excavation methods. • Ensure surface preparation. • Perform material placement (lift thickness). • Perform material compaction tests (in situ). • Ensure adequate compaction equipment. • Perform compaction testing. • Perform rough grading. • Perform finish grading/proof rolling. • Perform survey control. • Inspect surface water run-on, run-off control. • Provide as-builts. • Ensure previous surface approved. • Ensure surface is free of ice, snow, and excessive water.
Utility Terminations	• Ensure that all utilities are terminated in accordance with the project technical plan and prior to demolition. • Ensure that the lockout/tagout of pressure and electrical utilities is performed. • Verify that utilities are terminated in accordance with utilityspecifications.
Emissions/ Dust Control	• Ensure dust is controlled and do not exceed the action levels identified in the HASP.
Material Management and Staging	• Ensure proper segregation of recyclable materials. • Ensure demolition debris is segregated and staged in accordance with the project technical plan.
Decontamination of Equipment	• Ensure decontamination area laid out per drawings and plans. • Ensure proper decontamination equipment installed.

Table 5-1. Project Inspection Activities by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Inspection
	• Provide waste collection system in place and appropriate for the job. • Provide spill prevention and recovery plan in place. • Ensure equipment is properly decontaminated. • Ensure sufficient equipment and supplies on hand. • Ensure waste containers are correctly staged, labeled, and inventoried.
Site Restoration/ Landscaping	• Provide layout drawings. • Provide restoration methods and limits. • Ensure material/product quality (supplier certifications): seed, sod, sprigs, erosion control matting, mulch, fertilizer, vegetation). • Perform surface preparation. • Ensure topsoil suitability and placement. • Ensure material application (casting) rates. • Provide mulching and fertilizing. • Perform damage (e.g., washout) Repair. • Ensure defective material rejection. • Ensure unused material is properly stored.
Demobilization/ Project Closeout	• Inspect work areas to ensure all temporary facilities, equipment and materials are safely removed from the site. • Inspect work areas to ensure project housekeeping and cleaning. • Provide decontamination of equipment. • Perform completion inspection when work is substantially complete. • Provide punch lists on outstanding items. • Perform project housekeeping and final project cleaning. • Perform final inspections of all work areas. • Provide orderly site demobilization. • Ensure collation of site records and documents. • Transfer records and documentation to project manager. • Ensure purchase order closeouts. • Provide final reports and deliverables.

As additional project-specific tasks are identified, this QAP will be amended to include inspections for those tasks.

5.2 Punch List Inspection

Punch list inspections may occur near the completion of all work or any part thereof. The QC manager will conduct an inspection of the work and develop a punch list of items that do not conform to the approved drawings and specifications. The QC manager will include in the punch list any remaining items on a “rework items list” that were not corrected before the punch list inspection. The punch list will include the estimated date by which the deficiencies will be corrected. The QC manager or staff will make follow-up inspections to ascertain that all deficiencies have been corrected. Once this is accomplished, the contractor will notify the government that the facility is ready for prefinal inspection.

5.3 Prefinal Inspection

The contractor will perform a prefinal inspection to verify that the facility or work area is complete and ready to be occupied. The contractor will schedule and invite members from the end user of the site to participate in the prefinal inspection. A prefinal inspection list may be developed as a result of this inspection. Each deficiency noted in the punch list will identify the applicable reference (specification paragraph, drawing number, etc.) from which the deficiency stems. The QC manager will ensure all items on this list are corrected prior to notifying the owner that a final inspection with the stakeholders can be scheduled. Items noted during the prefinal inspection will be corrected in a timely manner and will be accomplished within the time slated for completion of the entire work, or any particular increment thereof if the project is divided into increments by separate completion dates.

5.4 Final Acceptance Inspection

The QC manager, construction manager, other project management personnel, and owner representatives will attend this inspection. Other owner personnel and stakeholders may also attend. The owner, based upon results of the prefinal inspection, will formally schedule the final acceptance inspection. Scheduling should be coordinated with the stakeholders at least 14 days prior to the final inspection. A final acceptance inspection will be considered closed when the work has been accepted by EPA and its stakeholders and the acceptance has been documented and signed by all parties.

SECTION 6

Performance Objectives and Acceptance Criteria

The overall performance objective is to ensure that the remedial design/remedial action is implemented in such a manner that all work performed:

- Complies with federal, state, and local regulations.
- Protects human health and the environment.
- Provides the owner with a usable product intended to meet the project objectives.
- Is cost effective.

SECTION 7

Testing Requirements

The QC manager is responsible for ensuring that the subcontractor performs all testing required, as identified in the final approved work plans. Completion of field tests will be documented in the Testing Plan and Log (Appendix A). The QC manager will obtain all test results from the subcontractor, update the Testing Plan and Log at a minimum of weekly, and maintain the records onsite in the project files. A copy of the Testing Plan and Log will be submitted to the QC manager at the end of each month.

As project-specific tasks are identified, the Testing Plan and Log will be amended to include monitoring tests and observations for those tasks. Table 7-1 lists specific monitoring requirements and observations.

Table 7-1. Construction Monitoring Tests and Observations by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Monitoring Test / Observation	Frequency
Utility survey		Once
Site preparation/ construction	Erosion and Sediment Control Measures	Daily
Initial material testing	Low-Permeability Soil Atterberg Limits (ASTM D 4318)	1 per fill source
Initial material testing	Low-Permeability Soil Particle Size Analysis (ASTM D 7928 and ASTM D 6913)	1 per fill source
Initial material testing	Low-Permeability Soil Moisture Content (ASTM D 2216)	1 per fill source
Initial material testing	Low-Permeability Soil Classification (ASTM D 2487)	1 per fill source
Initial material testing	Certification that material is free from environmental contamination	1 per fill source
Initial material testing	Low-Permeability Soil Compaction Curves (ASTM D 698)	1 per fill source
Initial material testing	Vegetative Cover (topsoil) Maximum Particle Size (ASTM D 7928 and ASTM D 6913)	1 per source
Initial material testing	Vegetative Cover (topsoil) Organic Content	1 per source
Initial material testing	Vegetative Cover (topsoil) pH	1 per source
Initial material testing	Certification that material is free from environmental contamination	1 per source
Construction	Low-Permeability Soil Particle Size Analysis	Every 1,500 tons
Construction	Low-Permeability Soil Atterberg Limits	Every 1,500 tons
Construction	Low-Permeability Soil Moisture-Density (compaction)	Every 1,500 tons
Construction	Low-Permeability Soil Nuclear Moisture Content	1 test per 200-foot grid per lift
Construction	Low-Permeability Soil Nuclear Density	1 test per 200-foot grid per lift
Construction	Vegetative Cover (topsoil) Maximum Particle Size	Every 7,500 tons
Construction	Vegetative Cover (topsoil) Organic Content	Every 7,500 tons
Construction	Vegetative Cover (topsoil) pH Testing	Every 7,500 tons
Construction	Low Permeability Soil Placement – 6-inch loose lifts	Daily during placement

Table 7-1. Construction Monitoring Tests and Observations by Task
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Task	Monitoring Test / Observation	Frequency
Construction	Vegetative Cover (topsoil) Placement – 6-inch single compacted lift	Daily during placement
Transportation and Disposal	Monitor trucks loading	During shipment
	Monitor truck weights to verify not overweight	

ASTM = ASTM International

SECTION 8

Submittal Review and Approval

Construction QC submittals are generated by either the QC manager or the subcontractor during or immediately before construction to demonstrate compliance with the project plans. Submittal requirements for projects are tabulated in the Submittal Register (Appendix A), in accordance with the requirements identified in the project plans.

The QC manager will log and track all submittals on the Submittal Register. Specific responsibilities regarding submittals include the following:

- Coordinating all submittal actions.
- Maintaining necessary submittal records in an organized manner.
- Maintaining and tracking submittals in the Submittal Register.
- Reviewing and certifying all submittals for compliance with the project plans, drawings, and specifications.
- Approving all submittals, except those designated to be approved by the technical lead (project plan's lead engineer), EPA, or stakeholders.
- Checking all material and equipment delivered to the project for compliance with the project plans, drawings, and specifications.

Certain designated submittals require approval by authorities other than the QC manager (such as the project manager, technical lead, or others). In such cases, the QC manager forwards the submittal to the project manager or project engineer, who then routes the submittal to the appropriate approver.

The construction manager and QC manager are responsible for coordinating the submittal relegation and approval process, and for ensuring that the process does not impact the project schedule.

8.1 Submittal Review and Control

The contractor will control and schedule all submittals and document the process in the Submittal Register. The QC manager is responsible for updating the Submittal Register at least weekly and for forwarding a copy of it to the project manager and QA/QC program manager at the end of each month. Each submittal will be routed on a standard submittal form. Units of weights and measures used on all submittals will be consistent with those used in the project documents.

Each submittal will be reviewed for completeness and compliance with contract requirements by the appropriate qualified individuals. The submittal reviewers and approvers will be designated before construction.

Before each submittal, the QC manager will certify that the submittal complies with the project requirements. Submittals that do not comply with the requirements will be returned to the originator for correction and resubmittal. Substitutions or variations of specified requirements will be clearly noted. Certification of the approved submittals will be indicated by signing or initialing and dating the submittal form by the QC manager. Submittals may include the following:

- Vendor design calculations, shop drawings, etc.
- Personnel qualifications (welding, etc.)
- Product data
- Permits

- Samples
- Catalog cuts/pages
- Production, inspection, and test reports
- Material certifications
- Progress reports, safety reports, manpower reports, etc.
- As-built or certified data
- Operation and maintenance manuals
- QC records and certifications
- Sample and test results
- QC reports
- Construction photographs
- Contract closeout documents
- Completed hazardous waste manifests and disposal certificates

8.2 EPA and Stakeholder Approval of Submittals

Any submittal that requires EPA approval should be clearly indicated in the technical sections of the specification or the drawings. Submittals for items that are extremely critical or complex, or are considered an extension of the work plan, should be submitted to EPA for approval. The submittals still require review for conformance and certification by the QC manager. This includes instances when the approver requires knowledge of the design assumptions and calculations.

As project-specific tasks are identified, the Submittal Register will be amended to include documentation requirements for those tasks.

SECTION 9

Change Control

Changes to final designs and project plans, field changes, or any other modifications are subject to design verification measures commensurate with those applied to the implementation work plan and draft project plans. The project manager approves work plan changes in consultation with the technical lead/lead engineer.

RFIs will be used to communicate and document clarifications and modifications requested by the subcontractor. The RFIs will be tracked and logged by the QC manager to ensure each RFI is fully addressed and that changes to the plans, drawings, and specifications are completely and accurately documented.

9.1 Construction Changes

Changes to materials, supplies, work approaches, and corrective action area designs during the construction effort will be documented in an overall effort to support sound engineering judgment and cost-effective project delivery. Changes during construction will be documented using the RFI process.

Changes to construction drawings as a result of an RFI will be identified with a symbol in the border identifying the RFI identification number and title. The drawing should also be marked with a cloud or circle to distinguish the change from the original drawings. The sheet will then supersede the existing drawing in the drawing set.

Note that the RFI process is a field construction tool for documenting changed field conditions or other issues that may require a deviation from project requirements identified in the drawings and specifications of the project plans. The RFI is intended to obtain input and concurrence from the Lead Engineer responsible for the development of the project plans. Approval of the RFI by the Lead Engineer does not constitute approval for the contractor or its subcontractors to perform work outside the project scope or budget. If an issue identified in the RFI requires a change to the project scope, schedule, or budget, it should be clearly conveyed in the RFI. In such instances, it is the responsibility of the project manager to work closely with the KA to seek and obtain proper approval from the EPA project manager and Contracting Officer (in accordance with established contract procedures) prior to implementing the change recommended in the RFI. All proposed changes will be reviewed and approved by EPA prior to finalizing any change.

SECTION 10

Noncompliance and Corrective Actions

The QC manager will notify the subcontractor of any detected noncompliance with the foregoing requirements. The subcontractor will take immediate corrective action after receipt of such notice. Such notification, when delivered to the subcontractor at the work site, will be deemed sufficient. If the subcontractor fails or refuses to comply promptly, the QC manager may issue an order stopping all or part of the work until satisfactory corrective action has been taken. Noncompliance notification or stop work orders will be documented in the Daily Report. Completion of corrective action will be noted on the Daily Report. Verification of the corrective action and its results will be performed by the QC manager and documented in the Daily Report.

10.1 Corrective Action Plan

Resolution of failing test results or noncompliance reports will be completed through a corrective action plan. The corrective action plan will be developed and documented by the QC manager in conjunction with the project manager. The agreed-upon corrective action plan will be implemented and documented by the QC manager. Completion of the corrective action plan is the responsibility of the QC manager.

SECTION 11

Quality Control Documentation

11.1 Daily Report

The daily report is an essential tool for recording and reporting daily production, safety, and QC activities of the project. The daily report is the daily record of operations on the job site and must be kept current. These reports are the official record of work performance and compliance with project plans, drawings, and specifications. It is therefore critical that the reports are accurate and timely.

The QC manager is responsible for preparing daily reports and submitting them weekly to the project manager and the QA/QC program manager. The QA/QC manager will obtain operational information from the construction manager (as well as any other contractor field personnel). The health and safety officer will provide information on all health and safety activities. The report also includes reports from each subcontractor working on the site, which will address, but is not limited to, the following:

- Quality aspects of the project being performed by the subcontractor
- Scheduling and resource issues
- Site safety inspections and concerns
- Environmental concerns
- Job progress
- Control inspections
- Tests performed and their results
- Crafts, personnel, and equipment onsite
- Material received

The project team must review the daily reports for accuracy and completeness because they are often used to prepare the final reports for the project. The project manager should review these reports and ensure that the QC process is working effectively on the project. The QA/QC program manager should review these reports and ensure the QA/QC processes and systems are working effectively on the program.

Appendix A contains the daily report template. The following items should be attached to the daily reports:

- Tailgate safety meeting minutes and signatures
- Project status meeting minutes
- Submittals
- Testing plan and log
- Permits
- Chain-of custody records
- Waste disposal documentation

Implementation of the QAP is documented and reported to EPA using a series of reports, submittals, and deliverables. Table 11-1 shows the deliverables, the parties responsible for preparing them, submission frequency, and relative content.

Table 11-1. Reporting and Field Documentation Required
Old American Zinc Superfund Site Fairmont City, St. Clair County, Illinois

Report or Documentation Requirement	Completed By	Delivered To	Frequency	Report Description
Daily Report	Construction Manager/Site Supervisor and/or QC manager	Project manager	Daily to QA/QC manager weekly.	Documents daily construction and QC activity. A Daily Report Template is included in Appendix A.
Weekly Update Report	Project Manager	EPA Work Assignment Manager	Weekly.	Presents a list of activities completed, any problems encountered, and the next week's activities.
Testing Plan and Log	QC manager	Project manager	As performed; attached to the last daily report submitted for each reporting period to QA/QC manager weekly.	Summarizes all testing activity conducted for the reporting period with test results (pass/fail). A Testing Plan and Log Template is included in Appendix A.
Project Status Meeting Minutes	QC manager	Project manager	Attached to the appropriate daily report to QA/QC manager weekly.	Minutes of any project status meeting held. A meeting minutes template is included in Appendix A.
Rework Items List	QC manager	Project manager	Monthly; attached to the last daily report submitted for each reporting period. To QA/QC manager monthly.	Documents rework items not corrected on same day as discovery. Includes items identified by both contractor and EPA or Stakeholder(s). A Rework Items List Template is included in Appendix A.
Submittal Register	QC manager	Project manager	Maintained through the life of the work assignment. To QA/QC manager monthly.	A part of each work assignment's construction quality plan; Specific to the construction activity for that contract task order. A Submittal Register template is included in Appendix A.
As-Built Records	QC manager	Project manager, EPA	Maintained in field through life of each work assignment; ensure to be complete and accurate by field engineer/QC manager upon completion of work assignment activities, included in the final report.	Requirements specified in each work assignment's construction quality plan; to be maintained at job site and inspected by QC manager to ensure daily maintenance.
Photographic Record	QC manager	Project manager	Maintained in field through the life of the work assignment.	Photographic record showing construction progress, special situations. A photograph log template is included in Appendix A.
RFIs	QC manager	Project manager, Lead Engineer	As required.	Standard form. Generated in the field; routed to the office for approval. Log maintained in the field. An RFI form is included in Appendix A.
Transportation and Disposal Log	QC manager	EPA Program Waste Coordinator and QA/QC manager	Monthly and maintained in field through the life of the work assignment.	Tracks waste on the project from generation to final disposition A template of the waste tracking log is included in Appendix A.

Documentation generated by the QC system must be maintained in an orderly fashion. It is suggested that the QC manager provide a series of 3-ring binders for ready reference. This information should be arranged by specification section and tabbed to include the following major milestone inspections and items:

- Punch list inspections
- Prefinal and final inspection results
- Rework items lists
- Test results
- Contract modifications and RFIs arranged in numerical order
- Noncompliance notices and corrective actions

11.2 Field Documentation Operating Procedures

The objective of the field documentation operating procedures is to ensure that appropriate project information is documented in logbooks during construction. This documentation is important for communicating activities with other staff members, EPA, and site personnel.

QC observations, inspections, and records of general QC activities on a regular basis are documented as follows:

- Record daily progress and associated QA/QC sampling
- Record construction operations, sequence, staging, etc.
- Maintain waste disposal records
- Describe deviations from expected conditions, or unexpected problems and their resolution

11.3 Site Preparation

Site preparation is performed by the subcontractor but will be observed by the QC manager with the following checks:

- Verify that equipment delivered to the site is the equipment specified.
- Confirm that a clearance check is performed to locate and identify each pipeline for all known utilities.
- Monitor the condition of the access roads. Verify that the proper signs are installed, the roads are maintained, and the road can accommodate construction traffic.
- Observe arrival and testing of materials to be installed as they are delivered onsite.
- Inspect all delivered materials to verify there are no defects in workmanship.
- Monitor delivery, handling, and storage of materials per the specifications.
- Verify storage facilities are protective and secure to prevent damage to equipment and materials per specifications.
- Review manufacturer material certifications.

11.4 Field Logbook

The QC manager will maintain a record of daily QC activities during construction in a field log book. The field logbook will be available upon request for review. As an operating procedure for logbook entries, the following items will be recorded, at a minimum:

- Date, project name, and location
- Time work begins every day
- Summary of weather conditions
- General description of work activities, size of work crew, and the equipment and personnel onsite
- Duration of lunch break
- Start time and duration of downtime resulting from equipment breakdown, weather, or plant emergencies, etc.
- Summaries of QC meetings and actions recommended to be performed
- QC testing of equipment and personnel
- Identification of work locations
- Description of materials delivered to the site, including QC data provided by the suppliers
- Record of decisions made regarding defective work or corrective actions implemented, or both
- Field tests
- Sampling activities

The QC manager will sign or initial the bottom of each page of the field log and date the entry to show that notes are being taken daily. A line-through will be placed on any portion of a log book page that is unused. In addition, the same information will be documented in the daily report.

SECTION 12

Schedule

A detailed project schedule will be prepared and updated monthly as part of the contract. The schedule will be submitted with the monthly invoice until the period of performance for the contract is reached.

SECTION 13

Glossary

Construction Quality Management Manual describes the quality systems and processes that are required to be implemented on contracts and projects executed by Construction Operations, including on design/build and at-risk construction projects. The quality systems and processes have been put into place in order to manage the risks and liabilities of the company, to ensure the quality and consistency of construction projects executed, and to provide our clients with products and services that meet or exceed their expectations at an acceptable cost and within budget.

Construction Quality Assurance/Quality Control Plan (QAP) establishes the guidelines and requirements to be used for project delivery to meet client objectives and achieve CH2M standards. The primary objective of the QAP is to document requirements, procedures, and methodology for QA/QC during construction of each project. (Reference SOP: ES-P2-03)

Quality Assurance (QA) refers to the overall quality process. It is the assurance that the construction effort is conducted in a manner consistent with the design.

Quality Control (QC) refers to a planned system for monitoring, controlling and documenting the quality of materials, supplies, and workmanship in a manner consistent with the execution plan and the drawings and specifications. These are the active tasks associated with quality management.

Project Instructions provide management instructions for construction operations, documentation, and reporting for work to be performed. The instructions provide guidance to the project team and clarify project manager expectations regarding personnel assignments, responsibilities, accountability, project goals, direction, processes, and procedures through the construction phase of the project. The project instructions define parameters for the implementation of the Project Quality Management Plan. (Reference SOP: ES-P2-02)

Contract-required submittals such as project plans, including work plans, HASPs, design drawings and specifications, reports, and as-built records, will be clearly identified during the proposal phase of the project. Contract-required submittals are items that are submitted to the customer and stakeholders for review and approval prior to and following construction activities.

Construction quality submittals are those submittals generated during or immediately prior to construction to demonstrate compliance with the project plans, drawings, and specifications. Construction quality submittals include daily reports, shop drawings, schedules, sample documentation, calibration records, photographs, product data, samples, field change request documentation, administrative and close-out submittals, and additional technical support data presented for review and approval.

Appendix A
Construction Quality Assurance Plan Forms

SUBMITTAL REGISTER

Project:	Old American Zinc Plant Superfund Site		Work Assignment No:	WA# 224-RDRD-B5A1	Activity / Task:	Facility Area Remedial Design					
Item No.	**Description of Submittal**	**Reference: Spec / Drawing**	**Approving Requirement: Approval (A) or Information (I)**	**Approving Authority: (CH or Contracting Officer or Rep)**	**Submittal Frequency: (One time, weekly, etc.)**	**Date Submitted to Approver**	**Approving Authority Name**	**Title / Company or Agency**	**Status: -Approved -Rejected**	**Date Approved**	**Remarks**
1	Project Work Plan/Execution Plan										
2	Health and Safety Plan										
3	Quality Control Plan										
4	Environmental Protection Plan										
5	Waste/Hazardous Waste Management Plan										
6	Request to Work Outside Regular Hours										
7	Utilities Outage Request										
8	Permits										
9	Laboratory Certification/Accreditation										
10	MSDS Sheets										
11	Contractor and Subcontractor Personnel List										
12	Original Waste Manifests										
13	Test Reports										
14	Testing Plan and Log										
15	QC Meeting Minutes										
16	QC Certifications										
17	Rework Items List										
18	Coordination and Mutual Understanding Meeting Minutes										
19	Photographic Records and Photo Log										
20	Material Specifications										
21	Subcontractor Field Notes										
22	Subcontractor Training and Experience Records										
23	As-Built Records										
24	Project Completion Report / Closure Report										
25	Daily Reports										

Testing Plan and Log

		WA No.:		WA Title:				Location:		
A	B	CTO No.:	D	E	F	G	H	I	J	K
Spec Section and Paragraph	Test Required	Proposed Lab	Sampled By	Tested By	Test Location	Frequency	Date Test Made	Test Results	Date Results Forwarded	Remarks

REQUEST FOR INFORMATION

Project Name/Description:	RFI No.:		Date Submitted:
Contract/TO No:	Project No:		

To:	Name	Title
From:	Name	Title

REFERENCES	
Document *(Work Plan, Scope of Work, etc.)*:	
Drawing(s)/Specification *(Drawing No, Specification No., etc.)*:	
Detail/Section *(Page No., Section No., Paragraph No., etc.)*:	
Discipline *(Architecture, Electrical, Mechanical, Chemical, Hydrogeology, etc.)*:	

POTENTIAL IMPACT: Cost ☐ Schedule ☐ Activity/Task Impacted:

REQUEST	
Requested By: *(Name/Company/Title)*	Response Requested by Date:
REPLY:	
Responded By: *(Name/Company/Title)*	Date of Response:
RESPONSE DISPOSITION/ CONCURRENCE:	
Response Dispositioned / Concurred With By: *(Name/Company/Title)*	Date Response Dispositioned Concurred With:

FURTHER ACTIONS REQUIRED:

REVIEW DISTRIBUTION			**FINAL DISTRIBUTION**		
☐ CH2M HILL PM	☐	☐	☐ CH2M HILL PM	☐	☐
☐ CH2M HILL CM	☐	☐	☐ CH2M HILL CM	☐	☐
☐ CH2M HILL QC	☐	☐ Project Files	☐ CH2M HILL QC	☐	☐ Project Files

DAILY REPORT

(ATTACH ADDITIONAL SHEETS IF NECESSARY)

CONTRACT NAME:		REPORT NO:	
CONTRACT NUMBER:		REPORT DATE:	
REVISION NUMBER:		REVISION DATE:	
TASK ORDER NUMBER:		PROJECT NAME / LOCATION:	
PROJECT NUMBER:		PROJECT DESCRIPTION:	
PROJECT MANAGER:		FIELD QUALITY MANAGER:	
CONSTRUCTION MANAGER:		SITE SAFETY MANAGER:	

AM WEATHER:		PM WEATHER:		MAX TEMP (F):		MIN TEMP (F):	

SUMMARY OF WORK PERFORMED TODAY

HEALTH AND SAFETY REPORT

SAFETY ACTIONS TAKEN TODAY/SAFETY INSPECTIONS CONDUCTED (Include Observations, Safety Violations, Corrective Instructions Given, Corrective Actions Taken, and Results of Safety Inspections Conducted:

TAILGATE TOPICS:

SAFE BEHAVIOR OBSERVATIONS:

OPERATIONS / PRODUCTION REPORT

WORK FORCE – CONTRACTOR AND SUBCONTRACTOR

Company	Cumulative Total of Work Hours From Previous Report	Total Hours Today	Total Work Hours From Start of Construction
CH2MHILL			

EQUIPMENT ON HAND

Description of Equipment	Make/Model/Manufacturer	Equipment ID Number	Inspection Performed By

COMMENTS (acceptance status, inspection findings, etc.):

WORK AND/OR TESTS ACCOMPLISHED OR IN PROGRESS

Performed Work / Test for Today:

Planned Work / Test for Tomorrow:

Planned Work / Test for Next Week:

CHANGED CONDITIONS/DELAY/CONFLICTS ENCOUNTERED (List any conflicts with the project [i.e., scope of work and/or drawings], delays to the project attributable to site and weather conditions, etc.)**:**

VISITORS AND DISCUSSIONS:

QUALITY CONTROL REPORT

MATERIALS DELIVERED TO JOB SITE

Quantity/Volume/ Weight	Description of Materials Received	Make/Model/Manufacturer	Material Lot Number	Inspection Performed By

COMMENTS (acceptance status, inspection findings, etc.):

INSPECTIONS PERFORMED

Task/Activity Inspected	Inspection Performed	Findings

TESTS PERFORMED

Task/Activity Tested	Test Performed	Test Results (Pass/Fail) - Criteria

QUALITY ISSUES AND RESOLUTIONS:

SUBMITTALS INSPECTION / REVIEW

Submittal No.	Submittal Description	Specification/Plan Reference	Submittal Approved?		Comment/Reason/Action
			Yes ☐	No ☐	
			Yes ☐	No ☐	
			Yes ☐	No ☐	
			Yes ☐	No ☐	

REGULATORY COMPLIANCE REPORT

PERMIT INSPECTIONS PERFORMED:

WASTE ACCUMULATION/STOCKPILE AREA INSPECTION

Inspection Performed By:		Signature of Inspector:	
Accumulation / Stockpile Area Inspected:			

No of Containers:		No of Tanks		No of Roll-Off Boxes:		No. of Drums	
Inspection Results:							

GENERAL COMMENTS

General Comments~ (rework, directives, etc.):

ATTACHMENTS

List of Attachments: (examples, as applicable: submittals, meeting minutes, safety meeting minutes, COCs, weight tickets, manifests, profiles, rework item list, RFIs, DCNs, photographs, etc.):

NOTE: Write all entries legibly in ink. Line out all unused portions or designate as "not applicable". Preparer signs first and last name on each completed daily report. This form may be filled out electronically and signed electronically.

PREPARER'S SIGNATURE DATE

PHOTOGRAPHS

Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	
Subject/Description:	
Photo Log No:	

Photograph Log

Project Number	Project Name	Site	Film Cassette Number	Photo Number	Date	Time	Task and Description	View Direction	Taken By

ES-P6-04B (REV 10.01.09)

WASTE TRACKING LOG

ES-P6-05A Transportation and Disposal Tracking Log

Version: 001, 10/01/09

Project Name:
Date:

Project Number	Task Order Number	Task Order Name	Site/Task Description	Container Type	Container Desig./No.	Accumula-tion Start Date	Waste Profile No. and/or Sample ID	(Sub)Con-tractor	Trans-porter	Date Trans-ported	Trans-porter DOT # & EPA ID	Disposal Facility	Disp Fac State ID &/or EPA ID	Matrix	Waste Type (Haz, Nonhaz, TSCA)	Waste Code (RCRA then State)	Disposal Facility Date (found on final manifest)	Manifest Number	Disposal Method (Enter disposal quantity under appropriate method)							Cert. of Disp/ Destruc Date	Comments/ Notes
																			Incin-eration	Landfill	Recycle	Onsite	Offsite Water Treatment	Other	Unit		

Column A - List CH2M HILL assigned project number
Column B - List Task Order number (if applicable)
Column C - Base or project name
Column D - List name of specific task or site (UST #35 or SWMU 68)
Column E - List type of container waste is placed (drum, rolloff, frac tank, stockpile, etc.
Column F - List number assigned to container
Column G - Date first drop/grain, etc. of waste placed into container/stockpile
Column H - Sample ID and/or profile number representing waste stream
Column I - Name of subcontractor handling T&D (lower tier sub)
Column J - Name of transporter removing waste from site
Column K - Date waste transported/removed from site
Column L - List transporter's DOT # and/or EPA ID # (EPA ID# only required for hazardous waste)
Column M - List name of disposal facility - list both intermediate and final facility name
Column N - List state ID # and/or EPA ID # (EPA ID# only required for hazardous waste). Note: list #'s for both intermediate and final facilit
Column O - List matrix of waste (soil, water, concrete, etc.)
Column P - Is waste hazardous, non-hazardous, petroleum contaminated, TSCA-regulated, etc.?
Column Q - List hazardous waste code(s) (D008, U228, etc.). RCRA then State as applicable
Column R - Date received by disposal facility (date found at bottom of final facility-signed manifest
Column S - List number of manifest used for waste tracking (top/left or middle of manifest
Column T through Y - Insert ACTUAL quantity from weight ticket or other quantity document in column associated with disposa
Column W - List quantities here if taken to DRMO, base POTW, on-site treatment, etc. Please specify where in Comments column
Column Z - Insert units applicable to waste; weight for solids, volumes for liquids
Column AA - Date of disposal, destruction or recycle per the Certificate of Disposal/Destruction/Recycle (CD). If not specified, may put date of actual CI
Column AB - Include any pertinent information not already listed

Note: All waste should be included on the Waste Tracking Log from the moment of generation.

Rework Items List

PUNCH LIST (REWORK ITEMS LIST)

PROJECT NAME:			PROJECT NUMBER						
Item No	Date Identified	Description	Referenced Spec or Drawing	Date Subcontractor Notified	Proposed Date of Action Completion	Action Performed	Resolution	Date Completed
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								

Appendix E
Operations and Maintenance Plan

LONG-TERM MAINTENANCE PLAN

Old American Zinc Plant Superfund Site
Fairmont City, Illinois
WA No. 224-RDRD-B5A1/Contract No. EP-S5-06-01

Prepared for

May 2018

Contents

SECTION 1

Introduction

This long-term maintenance (LTM) plan defines the activities required as part of the selected remedy for the Facility Area (FA) Remedial Design (RD) at the Old American Zinc (OAZ) Superfund Site, in Fairmont City, Illinois. LTM begins once construction is complete, defined by the U.S. Environmental Protection Agency (EPA) as “all components of the final remedy are in place and operating as designed.” This LTM plan may be updated following implementation of LTM (for example, during the 5-year reviews) to incorporate changes in LTM requirements. LTM activities at the site include cover maintenance and maintaining institutional controls.

SECTION 2

Site Characteristics

This section summarizes the history of the site, the regulatory history, and physical setting based on the information presented in the remedial investigation (RI) report (ENTACT 2009) and the feasibility study (FS) (ENTACT 2012).

2.1 Site Background and History

The OAZ Superfund Site is located in the Village of Fairmont City in St. Clair County, Illinois. The FA is bordered on the west by Garcia Trucking and N 45th Street, on the north by Maryland Avenue, on the east by General Chemicals and Kingshighway, and on the south by the CSX Intermodal railroad yard.

OAZ conducted zinc-smelting operations at the site from 1916 to 1967. Slag from the smelting operation was cooled by placing the molten material along the northern and western boundary of the FA. The slag stock piles originally encompassed an area of 15 acres. The site, including the clinker and other smelting residues on the property, was purchased by XTRA Intermodal, Inc. (XTRA), in 1979. XTRA operated a trucking terminal at the site until 2003 that included lease, storage, and maintenance of a diverse fleet of trailers. XTRA ground and re-distributed the slag stockpiles on the FA to buildup and level the former plant site to facilitate its trucking operation. At present, redistributed slag on the FA covers an area of 125 acres, with thicknesses ranging from 6 inches to 9 feet (ENTACT 2012).

2.2 Regulatory History

The information in the following paragraphs regarding the regulatory history of the site is summarized primarily from the RI report (ENTACT 2009) and the FS (ENTACT 2012).

Site investigations conducted at the site since 1994 detail the nature and extent of contamination in the FA and surrounding properties. ENTACT completed a RI and FS for the site in 2012, and identified contaminants in different media that included slag stock piles, ground slag that was used as fill material, and high metal concentrations in shallow groundwater in the FA. The impacted surrounding areas include residential, commercial, and vacant properties and village alleyways and drainageways that were contaminated with runoff from the facility. Ground slag was also transported to offsite properties by local businesses, residents, and the Village for surfacing village alleyways and used as fill material in residential properties (ENTACT 2012). Most of the impacted properties are located to the west of the site, with small pockets of trailer park and residential developments to the north, south, and east.

EPA, under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act, conducted a Time-Critical Removal Action (TCRA) from 2002 to 2003. A total of 462 offsite properties was sampled during the TCRA, of which 209 properties were found to have lead concentrations above the Remedial Action Level of 400 parts per million. Impacted soil was removed from 152 properties, with the remaining properties to be addressed under future remedial action. Following the completion of the RI/FS in 2012, a Record of Decision was issued by EPA detailing the selected remedial approach for the site. EPA entered into an Administrative Order on Consent with the potentially responsible party (PRP) in August 2014 to perform the RD work. The PRP was tasked with performing the RD work, and a draft final RD report (consisting of the report, selected drawings, but no technical specifications) was submitted to EPA in April 2016. In April 2016, the PRP filed for Chapter 11 bankruptcy and ceased performing additional work at the site. As a result, EPA took control of the site to complete the RD.

2.2.1 Existing Site Topography and Surface Water Drainage

2.2.1.1 Existing Site Topography

The site is partially developed with numerous gravel and slag roads, and remnant residue material from the former zinc-smelting operations stockpiled in the northern portion of the site. The habitat onsite is predominantly grassland and scrub where it is not covered by slag. Ground elevation within the site is predominately flat, with elevations ranging between 400 and 420 feet above mean sea level and a regional slope of 5 to 10 feet per mile to the southwest. Residue thickness varies from 0.5 to 9 feet within the site. Residue covers a significant part of the site's surface.

2.2.1.2 Surface Water Drainage

Surface water runoff from the FA is transported through a series of drainage ditches and Rose Creek, and ultimately flows to the Old Cahokia Watershed. Discharge to the watershed is made at two distinct points, referenced as the West Ditch Outfall and the Rose Creek Outfall. The western portion of the watershed drains to Schoenberger Creek, a tributary to the Cahokia Canal. These drainage features and water bodies are discussed in the following paragraphs.

The FA is drained by a set of four drainage ditches—two located in the eastern portion of the FA designated as East Ditch 1 and East Ditch 2, and two located in the western portion of the FA designated as West Ditch 1 and West Ditch 2. These ditches are all ephemeral and only flow in direct response to precipitation events. During dry periods the only water in these ditches is contained in isolated pools. During the summer months the water in these pools can get very warm and stagnant.

East Ditch 1 begins at the eastern edge of the FA east of the XTRA buildings and continues approximately 2,200 feet in a southwesterly direction across the far eastern portion of the FA, until its confluence with Rose Creek near the southeastern corner of the FA. This ditch is bermed with spoil and/or slag. East Ditch 2 begins at Kingshighway north of the Cargill Property and extends west for approximately 800 feet to its confluence with East Ditch 1, approximately 600 feet upstream of Rose Creek.

The western and northwestern portion of the FA is drained by West Ditch 1, which runs along the western border of the FA. This ditch continues across the northwestern corner of the FA and thence along Maryland Avenue, where it is conveyed through a culvert beneath Collinsville Road. This ditch discharges into the Old Cahokia Watershed at the West Ditch Outfall, approximately 0.25 mile north of the FA (Figure 4). West Ditch 2 is in the southwestern corner of the FA and is a very shallow, 800-foot-long, erosional swale that discharges to Rose Creek via a culvert outfall at the extreme southwestern corner of the FA.

Rose Creek is a shallow ephemeral stream that flows in a westerly direction past the south edge of the FA. Prior to reaching the FA's southern boundary, Rose Creek flows along the southern boundary of the General Chemical property, crossing beneath Kingshighway and along the Cargill property's southern boundary. East Ditch 1 joins with Rose Creek near the southeastern corner of the FA. From this point, Rose Creek flows westerly along the southern boundary of the FA, where West Ditch 2 joins the creek. Rose Creek continues in a general westerly direction approximately 4,000 feet along the northern side of the CSXI railroad corridor, to a point approximately 600 feet from Collinsville Road, where it bends to the northwest. Beyond this bend, Rose Creek flows in a northwesterly direction for approximately 800 feet, where it is conveyed via a culvert beneath Collinsville Road. North of Collinsville Road, the creek discharges into the Old Cahokia Watershed at the Rose Creek Outfall, approximately 0.75 mile west of the western boundary of the FA.

Like the ditches draining the FA, Rose Creek only flows in direct response to precipitation events. The 4,000-foot segment of the creek between the FA and Collinsville Road is typically dry, with isolated small pools of water. During the drier portions of the year, the water in the pools becomes very stagnant.

Schoenberger Creek is located south of the FA, and this creek does not receive surface water runoff or groundwater recharge from the FA. The creek flows in a westerly direction before it is diverted north through a culvert under Collinsville Road into the Old Cahokia Watershed. The creek continues north through the watershed for approximately 1,400 feet, and then trends westerly. Schoenberger Creek is channelized at this point, and hydraulically isolated from the wetlands of the watershed via border spoil banks. The watershed discharges into Schoenberger Creek via two culverts at points just north of Collinsville Road. Schoenberger Creek continues to flow west for approximately 0.6 mile, where it converges with a tributary of the Cahokia Canal. According to a 1998 U.S. Geological Survey aerial photograph, the tributary flows north to Cahokia Canal, which meanders west approximately 0.4 mile, then south for approximately 1.0 mile, and west again approximately 0.7 mile into the Mississippi River via a discharge gate that flows under a railroad corridor.

2.2.2 Soil and Geology

The geology generally consists of a surficial horizon of slag/fill material overlying unconsolidated inter-fingering clay, silt, and sand fluvial and glacial deposits reaching depths of more than 120 feet. The unconsolidated deposits overly a Mississippian-aged claystone, shale, limestone, and dolomite bedrock.

The fill materials on the FA consist of (1) black, dry, dense, ground slag/slag-like granular fill distributed across the FA by XTRA as part of its resurfacing activities and/or (2) demolition-type materials (i.e., bricks, gravel, concrete, wood, etc.) from the demolition of the former smelter facilities. In some areas, the ground slag was covered by XTRA with rotomill or gravel in response to community complaints of blowing slag. The depth of the slag/fill materials across the FA ranges from 0.5 to 9 feet below ground surface (bgs), with a calculated average depth of 3.5 feet bgs. In the low-lying, unvegetated areas in the northern portion of the FA, the fill material consists of a soft, dry, grey to black talc-like powder that reaches a thickness of 6 inches.

The native unconsolidated deposits underlying the fill consist of inter-fingering horizons of clays, silts, and fine sands until depths of approximately 70 feet bgs, where the deposits become fine sand grading with depth to medium to coarse sand with sand and gravel horizons. The upper 50 feet beneath the FA appears to be associated with the Cahokia alluvium, which is described as consisting of poorly sorted silt, clay, and silty sand with localized lenses of sand and gravel that varies considerably in thickness but rarely exceeds 50 feet bgs (Willman et al. 1975). The Cahokia alluvium overlies a glacial outwash formation associated with the Henry Formation and is composed primarily of fine to coarse sand grading to sand and gravel deposits (Illinois Department of Public Health 1998). The unconsolidated deposits near the site extend to depths of 90 to 120 feet, where bedrock is encountered.

2.2.3 Site Groundwater

Groundwater is encountered in the shallow Cahokia alluvium, the deeper and more extensive Henry Formation Outwash, and the underlying bedrock. Based on limited yield and abundance of fines, the shallow Cahokia alluvium deposits are not used for potable purposes in the site area as determined by well survey results. The major aquifers in the area are the Henry Formation Outwash and gravel outwash aquifer encountered between 75 and 90 feet bgs, and the Valmeyer Bedrock Formation encountered at depths greater than 120 feet near the site.

The uppermost shallow saturated horizon was encountered between 15 and 18 feet bgs within a silty sand (SM) horizon or fine well-sorted sand with some silt (SP-SM) horizon. Based on the FA borings advanced during the RI, groundwater is initially encountered between 13 feet and 20.5 feet bgs in thin horizons of silt, sandy silt, silty sand, sand, and clayey sand deposits associated with the Cahokia alluvium. Based on FA boring logs installed as part of the RI, these interfingering silty to fine sand, silt, and clay layers extend to a depth of 74 feet, where the deep borings terminated.

The quarterly groundwater elevations from all wells collected across the FA (except MW-03) were used to determine groundwater flow direction across the FA. The groundwater flow direction in the shallow unconfined horizon is predominantly west to northwesterly across the FA, with slight seasonal variations.

Hydraulic conductivity within the groundwater-bearing zones was determined by performing in situ aquifer (slug) tests on monitoring wells. Conductivity values at the site range from 0.0108 feet per day to 0.212 feet per day. These values are within the literature-based typical hydraulic conductivity range for silt and silty sand as presented in *Groundwater* (Freeze and Cherry 1979).

SECTION 3

Long-Term Maintenance

LTM generally will consist of monitoring, inspections, maintenance, and maintaining institutional controls. General procedures for monitoring and inspections described herein are intended to guide personnel performing LTM activities. The guidelines will be modified as needed in the LTM plan to reflect actual LTM procedures.

3.1 Consolidation Area Inspection

Consolidation area inspection will include inspection for cover penetration or damage, for erosion control, and for vegetative stress due to leachate seeps. The inspections will occur quarterly for the first year following completion of the consolidation area cover, semiannually for the second year, and annually thereafter. Attachment A contains an example inspection checklist.

3.1.1 Cover Penetration or Damage

The consolidation area cover will be inspected to verify that no section has been penetrated or damaged due to settlement (including minor depressions in the consolidation area cover surface and significant grade changes over large parts of the consolidation area cover), cracking, burrowing animals, and vandalism. If the cover inspection occurs during or after a significant storm, areas of settlement requiring attention can be identified by areas of ponded or poorly draining stormwater.

3.1.2 Erosion Control

Temporary erosion controls established during site construction will not be removed until vegetation is established; temporary controls will be inspected during long-term maintenance inspections to verify that they are functioning as designed. The drainage channels and banks will be inspected to check that stones are not dislodged and that scouring of supporting materials has not occurred. If erosion has occurred, the channels or banks will be restored, which may include placement of sod, erosion control matting, or both. Rock-lined channels and outlets will be inspected for soil deposition or stream erosion. Deposited sediment will be removed.

3.1.3 Vegetative Stress

The consolidation area cover will be inspected for vegetation stressed by lack of moisture (rainfall) and the generation of consolidation area leachate seeps. Seeps, if discovered, will be addressed case-by-case, depending on size and volume.

3.1.4 Reporting

An annual monitoring report will be prepared for inspection and maintenance conducted that year. The monitoring report will include a description of maintenance activities, inspections, necessary repairs, and institutional controls described in Section 3.3.

3.2 Consolidation Area Maintenance

Maintenance will include mowing and the necessary maintenance and repairs recommended as a result of consolidation area inspection activities.

3.2.1 Cover Restrictions

Activities that may damage the integrity of the consolidation area cover are prohibited. This includes excavations and permanent storage of equipment on the consolidation area cover. Vehicular traffic will be limited only to that needed for LTM (light vehicle access). Mowing should not take place immediately following heavy rainfall, to avoid damaging the cover.

3.2.2 Grass Mowing

The grass on the consolidation area cover will be mowed (1/3 of the area each year), so that the entire area is mowed once every 3 years, which will inhibit growth of woody plant species.

3.2.3 Cover Defects

Defects in the consolidation area cover identified during inspections will be corrected as soon as possible.

3.2.4 Reporting

One annual monitoring report will be prepared each year for inspection and maintenance conducted that year. The monitoring report will cover grass mowing, inspections, necessary repairs, and institutional controls.

3.3 Institutional Controls

The remedial action for the FA includes institutional controls that will be implemented through the conveyance of an environmental covenant, to restrict future use of and access to the area surrounding the consolidation area and to restrict future use of the rest of the FA so as to prevent intrusive activities and contact with waste. At least once annually, the FA will be inspected to determine if use of the site is consistent with the institutional controls. The inspection results, along with maintenance and repairs, will be documented.

3.4 Five-Year Performance Reviews

The National Oil and Hazardous Substances Pollution Contingency Plan requires 5-year site reviews, as long as hazardous substances remain at the site that do not allow unlimited use and unrestricted exposure. The purpose of the 5-year review is to evaluate the implementation and performance of the remedy to determine it is protective of human health and the environment. The 5-year review reports will evaluate the status of the remedial action, including monitoring frequency, duration of continued monitoring, condition of the consolidation area cover, status of inspections and maintenance, and the effectiveness of institutional controls. The process will stimulate a review of the LTM program and document necessary modifications resulting from the review process. The first 5-year remedial performance review will occur in 2023, assuming the remedial action is implemented in 2018.

Five-year reports will address the following:

- Site description
- Remedy background
- Status of monitoring program
- Inspection results
- Effectiveness of institutional controls
- Conclusions and recommendations

References

ENTACT, LLC (ENTACT). 2009. *Final Remedial Investigation Report, Old American Zinc Plant Site, Fairmont City, Illinois.* March.

ENTACT, LLC (ENTACT). 2012. *Final Feasibility Study Document for the Old American Zinc Plant Site, Fairmont City, Illinois.* February.

Illinois Department of Public Health. 1998. *Health Consultation for Swift Agricultural Chemicals, St. Clair County, Fairmont City, Illinois*. April.

Freeze, R.A. and J.A Cherry. 1979. *Groundwater*. Englewood Cliffs, New Jersey: Prentice-Hall. TIC 217571.

Willman, H.B., et al. 1975. *Handbook of Illinois Stratigraphy, Illinois State Geological Survey: Bulletin 95*. Urbana, State of Illinois Department of Registration and Education.

Attachment A
Consolidation Area Cover Inspection Form

OLD AMERICAN ZINC
CONSOLIDATION AREA COVER INSPECTION FORM

Inspection Date: **Inspector Name:**

Drainage Swales, Culverts, Access Roads	Yes	No	Comments & Deficiencies Noted (Required if Shaded Area Selected)	CA Completion (Date/Initials)
Are Drainage Swales in Good Condition?				
Are Access Roads in Good Condition?				
Are Culverts in Good Condition?				
Perimeter Security (Fences & Gates)	**Yes**	**No**	**Comments & Deficiencies Noted (Required if Shaded Area Selected)**	**CA Completion (Date/Initials)**
Are Security Signs in Place?				
Are all Gates Locked?				
Is Fence in Good Condition?				
Are there Signs of Vandalism?				
Is Vegetation growing on Fence or Gates?				
Area Cover	**Yes**	**No**	**Comments & Deficiencies Noted (Required if Shaded Area Selected)**	**CA Completion (Date/Initials)**
Are there Signs of Stressed or Dead Vegetation?				
Has the cell been mowed recently?				
Is there Woody Growth?				
Are there Signs of Erosion, Furrows, Ruts, Penetrations, Cracking or Animal Burrows?				
Are there any Areas of Ponding Water?				
Any evidence of vandalism to the Cover?				
Is there any Evidence of Slips?				
QUARTERLY INSPECTIONS				
Surface Water Conveyance	**Yes**	**No**	**Comments & Deficiencies Noted (Required if Shaded Area Selected)**	**CA Completion (Date/Initials)**
Are there Signs of Stressed or Dead Vegetation?				
Are there Signs of Erosion, Furrows, Ruts, or Animal Burrows?				
Are there Signs of Erosion or other Problems?				
Is there any accumulated Debris in channels?				
Is there any Buildup of Excess Sediments at the Culverts or Spillways?				

CA - Corrective Action

Appendix F
Engineer's Estimate of Construction Cost

APPENDIX F

Construction and capping of consolidation area

Old American Zinc Plant Superfund Site

St. Clair County, Illinois

SCOPE:

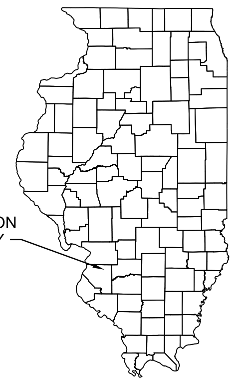
251,252 CY of slag and 628,912 CY of clay excavated from previous mine slag stockpile area and reclaimed by redepositing slag beneath clay in an excavated cell, topsoil and landscaping

Item	Qty	Unit	Unit Price		Notes
Pre-construction Activities					
Implementation Plans/Submittals	1	LS	$ 23,000	$ 23,000	Work Plan/Schedule; H&S Plan; CQP; WMP; SWPPP and updates. Also includes equipment/material submittal preparation and revisions.
Pre-construction Meeting	1	LS	$ 6,000	$ 6,000	Pre-construction meeting with the Prime Contractor, primary subcontractors, and the client to discuss implementation plans, schedule, etc.
Permitting	1	LS	$ 9,000	$ 9,000	Allowance for anticipated permits, including, but not limited to, grading/earthwork; air; storm water.
Construction Activities					
Mobilization/Site Setup (Season 1)	1	LS	$ 110,000	$ 110,000	Mobilize equipment and materials to site and prepare staging areas. Document existing condition of haul routes with photos and videos. Includes utility locates; Contractor monthly home office support, QC support, etc.
Mobilization/Site Setup (Season 2)	1	LS	$ 58,000	$ 58,000	Mobilize equipment and materials to site and prepare staging areas. Document existing condition of haul routes with photos and videos. Contractor monthly home office support, QC support, etc.
Survey	1	LS	$ 139,000	$ 139,000	Surveying services throughout the duration of the project, including intial site survey.
Temporary Facilities	18	MO	$ 6,000	$ 108,000	Monthly cost of temporary facilities, utilties, radios, phones, temp power that are needed throughout the duration of the field work.
Install/Maintain erosion controls	12,000	LF	$ 5	$ 60,000	Installation/maintenance/removal of silt fencing and other erosion controls throughout the project.
Clearing & Grubbing	1	LS	$ 7,000	$ 7,000	Minor clearing required.
Air Monitoring	154	DY	$ 1,600	$ 247,000	Labor, equipment, and materials to conduct air monitoring at facility during construction. Personnel monitoring, continuous monitoring with status checks every 30 minutes, and periodic air sampling.
Stormwater Management	50,000	GAL	$ 4	$ 200,000	Tentatively assumed 50,000 gallons of stormwater to be managed accumulative 66 days during site work.
Slag Removal (Consolidation Area)	234,695	CY	$ 10	$ 2,347,000	
Slag Removal (Clay Stockpile Cover and Place)	1,345	CY	$ 8	$ 11,000	
Slag Removal (Clay Stockpile Fill and Place)	15,212	CY	$ 11	$ 168,000	
Pulverizing Concrete Foundations	500	CY	$ 200	$ 100,000	Unknown amounts of concrete foundations could be encountered. Pulverized prior to being included in the stockpile. Assumed 500CY
Clay Excavation (Consolidation Area)	375,780	CY	$ 8	$ 3,007,000	
Clay Placement (Stockpile Cover)	112,368	CY	$ 9	$ 1,012,000	
Clay Placement (Stockpile Site Fill)	140,764	CY	$ 9	$ 1,267,000	
Haul Stockpiled Slag to Consolidation Area	312,367	CY	$ 7	$ 2,187,000	Compaction and Grading included
Stockpile Management	264	DY	$ 3,000	$ 792,000	
Excavate&Haul In-place Slag to Consolidation Area	480,274	CY	$ 10	$ 4,803,000	Compaction and Grading included
Place and compact Clay Cover (Consolidation Area)	112,368	CY	$ 10	$ 1,124,000	Compaction and Grading included
Compaction Testing	30	DY	$ 2,500	$ 75,000	Cost based on previous projects
Final Fill and Grading (Site Clay)	263,534	CY	$ 13	$ 3,425,942	Compaction and Grading included
Topsoil Layer	222,502	CY	$ 47	$ 10,458,000	Cost to cover purchasing, hauling, placing, compacting, and grading 12-in layer of topsoil across the site.Cost based on local vendor quotes
Seed, Mulch, Erosion Matting	25	ACRE	$ 7,000	$ 175,000	Assumed hydroseeding
Landscape Warranty	12%	of	$ 175,000	$ 21,000	12% of the Seed, Mulch, Erosion matting task
Site Cleanup	1	LS	$ 13,000	$ 13,000	
Final Survey	1	LS	$ 12,000	$ 12,000	
Demobilization (Season 1)	1	LS	$ 50,000	$ 50,000	
Demobilization (Season 2)	1	LS	$ 50,000	$ 50,000	
Post Construction Activities					
Long Term Maintenance	1	LS	$ 782,000	$ 782,000	O&M Activities include quarterly 1st year inspections, semiannual 2nd year inspections, annual thereafter inspections with respective reporting efforts, and 5-year reporting and review. Mowing every 3 years and other general inspections and repairs for maintaining cap integrity.
			Pre-Bond, Contingency:	$ 32,846,942	
Payment and Performance Bond	2.50%	of	$ 32,846,942	$ 821,174	
Contingency	25%	of	$ 32,846,942	$ 8,211,736	EPA Guidance document
			Subtotal:	$ 41,879,851	
Project Management/Construction Management					
Project Management	5%	of	$ 41,879,851	$ 2,093,993	
Design	6%	of	$ 41,879,851	$ 2,512,791	
Construction Management	6%	of	$ 41,879,851	$ 2,512,791	
			Total Capital Cost:	$ 48,999,426	
CLASS 4 RANGE:			**50%**	$ 73,499,139	
			-30%	$ 34,299,598	

This construction cost estimate is not an offer for construction and/or project execution. The construction cost estimate for this Design is an Association for the Advancement of Cost Engineering (AACE) Class 4 estimate and is assumed to represent the actual total installed cost. The estimate above is considered control-level cost estimating, suitable for use in project budgeting and planning. This estimate has been prepared with partial design and engineering calculations. The level of accuracy for the class of estimate defines the upper and lower ranges of the cost estimate. It is based upon the level of design detail and uncertainty associate with that level of detail. For a Class 4 estimate, the accuracy range is +50% to -30%. It would appear prudent that internal budget allowances account for the highest cost indicated by this range as well as other site specific allowances. The cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Appendix G
Drawings

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

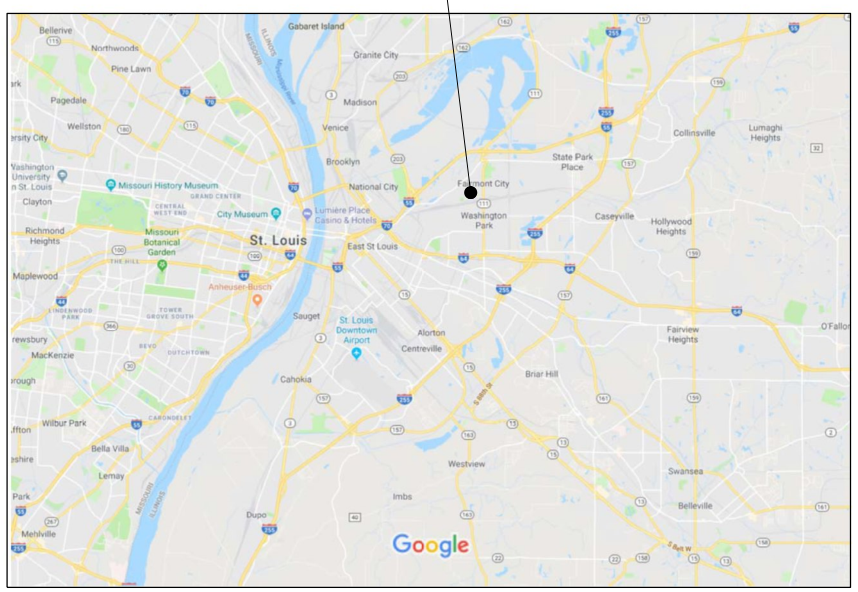


PROJECT LOCATION
ST. CLAIR COUNTY

ILLINOIS

N

PROJECT LOCATION
FAIRMONT CITY



VICINITY MAP
NTS

N

INDEX TO DRAWINGS

PROJECT LOCATION
FACILITY BOUNDARY

LOCATION MAP
NTS

N

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY DR D SCHAUER CHK APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

GENERAL
TITLE, LOCATION MAPS AND INDEX TO DRAWINGS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	G-001
SHEET	1 of 13

DESIGN REVIEW

ABBREVIATIONS

@	AT
AVE	AVENUE
BOT	BOTTOM
CIP	CAST IRON PIPE
CMP	CORRUGATED METAL PIPE
CONC	CONCRETE
DIA	DIAMETER
DIP	DUCTILE IRON PIPE
DR	DRIVE OR DIMENSION RATIO
E	EAST
EL	ELEVATION
EXST	EXISTING
EW	EACH WAY
FM	FORCE MAIN
FO	FIBER OPTIC
G	GAS
GM	GRAVITY MAIN
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
INV	INVERT
IP	IRON POST
LT	LEFT
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MJ	MECHANICAL JOINT
N	NORTH
NCP	NONREINFORCED CONCRETE PIPE
NO	NUMBER
NTS	NOT TO SCALE
OC	ON CENTER
OD	OUTSIDE DIAMETER
OHP	OVERHEAD POWER
PE	PERMANENT EASEMENT
PL	PROPERTY LINE
PP	POWER POLE
PVC	POLYVINYLCHLORIDE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD
REQD	REQUIRED
RJ	RESTRAINED JOINT
RT	RIGHT
RR	RAILROAD
R/W	RIGHT OF WAY
S	SOUTH
SD	STORM DRAIN
SDR	STANDARD DIMENSION RATIO
SN	SEWER MANHOLE NUMBER
SPECD	SPECIFIED
SS	SANITARY SEWER
SST	STAINLESS STEEL
STA	STATION
T, TEL	TELEPHONE
TE	TEMPORARY EASEMENT
TV	TELEVISION
TYP	TYPICAL
UGP	UNDERGROUND POWER
VERT	VERTICAL
W	WATER, WEST
W/	WITH
WT	WEIGHT

NOTE:
1. CONTACT THE ENGINEER FOR ABBREVIATIONS NOT LISTED.

SECTION / DETAIL DESIGNATIONS

SECTION (LETTER) OR DETAIL (NUMERAL) DESIGNATION

A

DRAWING NUMBER (REPLACED WITH A LINE IF TAKEN AND SHOWN ON SAME SHEET)

1 C-501

ON DRAWING WHERE SECTION OR DETAIL IS TAKEN:

DRAWING NUMBER WHERE SHOWN

B SECTION
SCALE
100-S-3001

ON DRAWING WHERE SECTION IS SHOWN:

DRAWING NUMBER(S) WHERE TAKEN

2 DETAIL
SCALE
200-M-10B10A

ON DRAWING WHERE DETAIL IS SHOWN:

DRAWING NUMBER(S) WHERE TAKEN

DRAWING TITLE
SCALE

ON DRAWING WHERE ONLY A TITLE IS REQUIRED WITH NO REFERENCE (eg: ELEVATIONS)

B

SECTION CALLOUT WHERE SECTION IS ON THE SAME SHEET AND CUT EXTENDS TO A FIXED LIMIT

B C-501 B C-501

SECTION CALLOUT WHERE SECTION IS ON ANOTHER SHEET AND CUT EXTENDS THROUGHOUT ENTIRE SHEET

1 KEYNOTE NUMBER

1 REVISION / ADDENDA NUMBER

N NORTH ARROW

DESIGN DETAIL DESIGNATION

DESIGN DETAIL DESIGNATION (NUMERAL) SHOWN ON DESIGN DETAIL DRAWING(S)

1234-567

NOTES:
1. ALL DESIGN DETAILS ARE TYPICAL AND MUST BE USED IF DESIGN DETAIL DESIGNATION IS NOT SHOWN
2. THE TERM STANDARD DETAIL, OR A FORM OF IT, IS SYNOMONOUS WITH DESIGN DETAIL. THE DESIGN DETAILS REPRESENT THE CHARACTER AND NATURE OF THE WORK REQUIRED THROUGHOUT THE PROJECT. ALL ASSOCIATED WORK SHALL BE IN ACCORDANCE WITH THE DESIGN DETAILS SHOWN WHETHER THE DETAILS ARE SPECIFICALLY REFERENCED OR NOT.

CIVIL LEGEND

STOCK PILE AREA

CONTRACTOR STAGING/PARKING AREA

HAUL ROUTE DIRECTION OF TRAVEL

DITCH / DIRECTION OF FLOW

PROPOSED SECURITY FENCING

EXISTING FENCING

SEDIMENTATION FENCING

EXISTING CONTOUR

PROPOSED CONTOUR

FACILITY AREA BOUNDARY

LIMITS OF DISTURBANCE

DITCH

NOTE:
IN GENERAL, EXISTING ITEMS ARE SHOWN LIGHT LINED (SHADED). NEW MODIFICATIONS ARE SHOWN IN HEAVY (NON-SHADED) LINE WEIGHTS.

GENERAL NOTES

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY DR D SCHAUER CHK APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m:

GENERAL
LEGEND AND GENERAL NOTES

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	G-002
SHEET	2 of 13

DESIGN REVIEW

GENERAL SHEET NOTES

1. EXISTING CONTOURS AND FEATURES SHOW AS DARK LINE THIS DRAWING. IN GENERAL EXISTING CONTOURS AND FEATURES ARE SHOW LIGHT LINED (SHADED) AND PROPOSED CONTOURS AND FEATURES ARE SHOWN AS DARK LINED (NON-SHADED). REFER TO DWG G-002.

N

0 200 400 600

1"= 200'

NO.	DATE	REVISION	BY	APVD
DSGN	T OXLEY	DR	D SCHAUER	CHK	APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m:

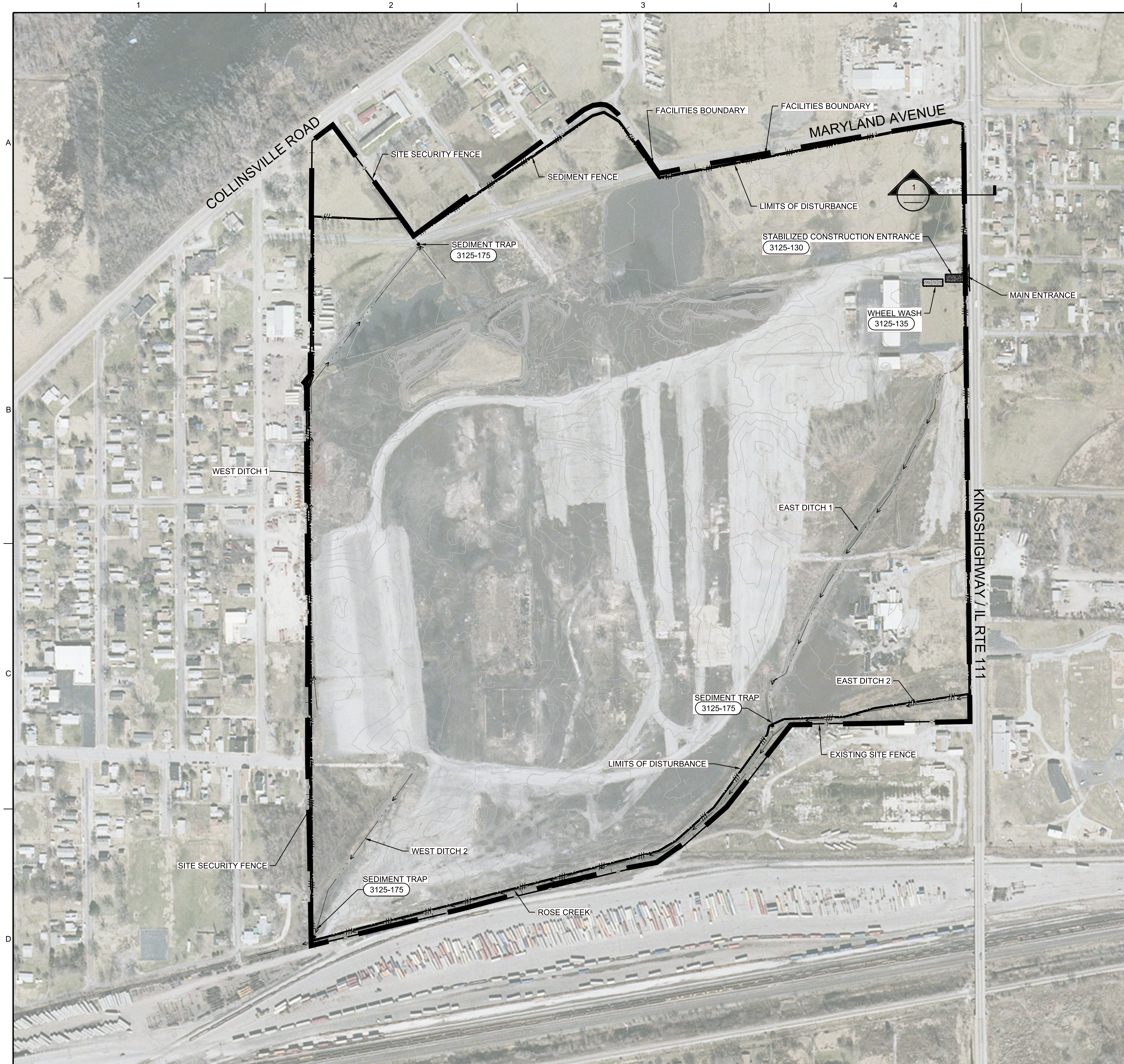
CIVIL

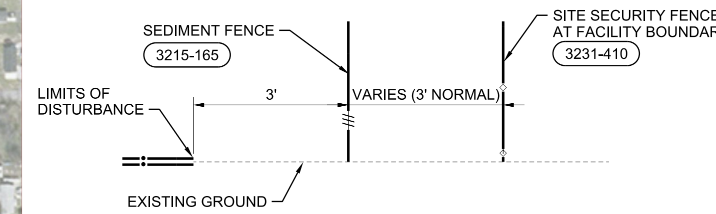
FACILITIES AREA
EXISTING CONDITIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

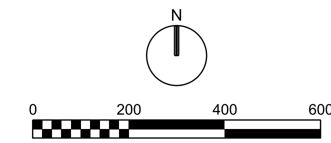
DATE	APR 2018
PROJ	687729
DWG	C-001
SHEET	3 of 13

DESIGN REVIEW





1 SECTION AT FENCING
NTS



REVISION				
NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	APVD	
T OXLEY	D SCHAUER			

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m:

CIVIL
EROSION AND SEDIMENT CONTROL PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-002
SHEET	4 of 13

DESIGN REVIEW

SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

N

0 200 400 600

1"= 200'

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m.

CIVIL

SEQUENCE OF CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-003
SHEET	5 of 13

DESIGN REVIEW

SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m.

CIVIL

CONSOLIDATION AREA PREP

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-004
SHEET	6 of 13

DESIGN REVIEW

SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

0 200 400 600
1"= 200'

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m

CIVIL

CONSOLIDATION AREA EXCAVATION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-005
SHEET	7 of 13

DESIGN REVIEW

SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

N

0 200 400 600

1"= 200'

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m:

CIVIL

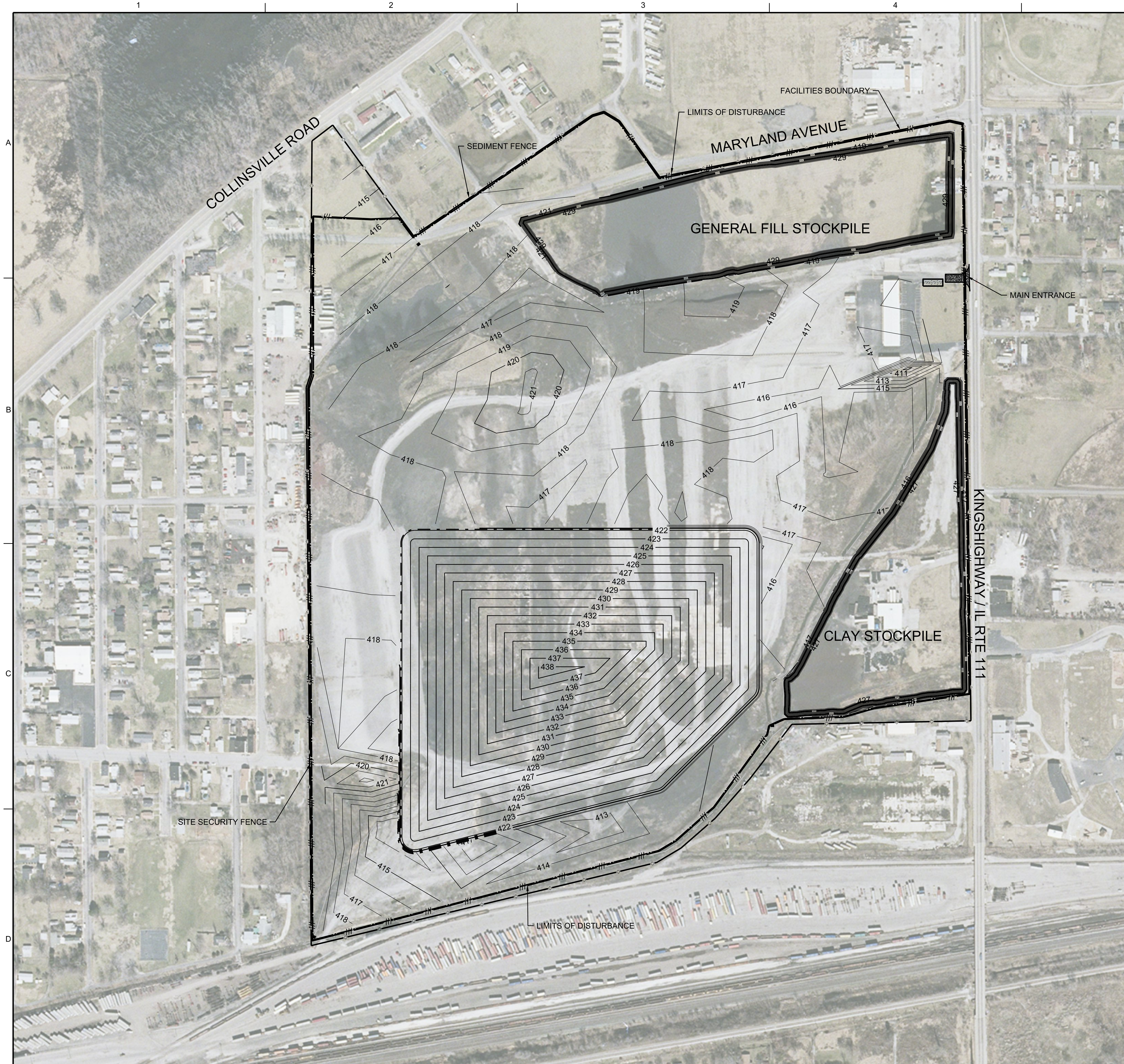
CONSOLIDATION AREA CONSTRUCTION

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-006
SHEET	8 of 13

DESIGN REVIEW



SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. **PLACE CLAY COVER OVER CONSOLIDATION AREA.** SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m.

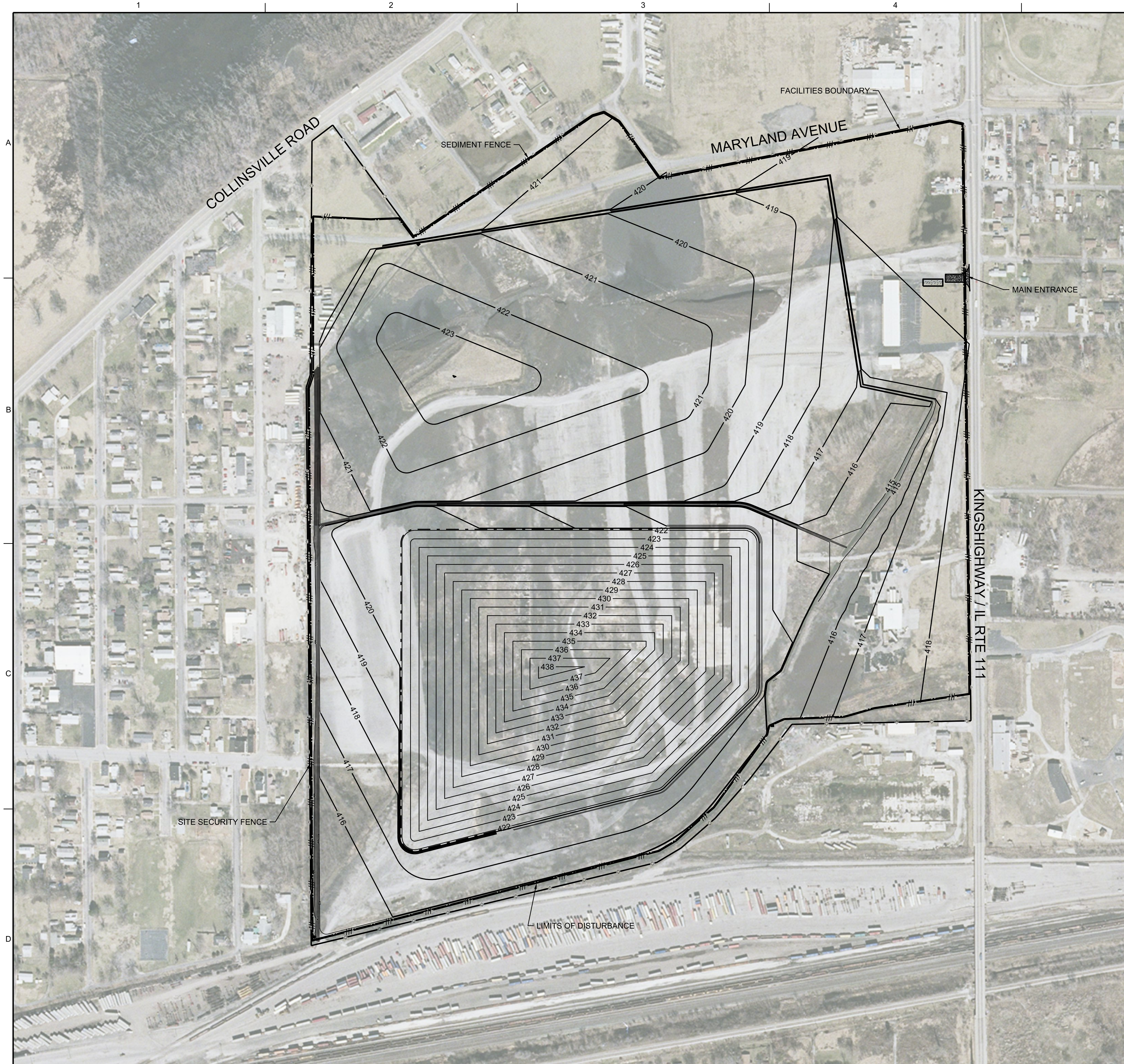
CIVIL

CONSOLIDATION AREA CONSTRUCTION CLAY COVER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	APR 2018
PROJ	687729
DWG	C-007
SHEET	9 of 13

DESIGN REVIEW



N

0 200 400 600

1"= 200'

SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE. SEE DWG C-009.

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
T OXLEY	D SCHAUER		

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m

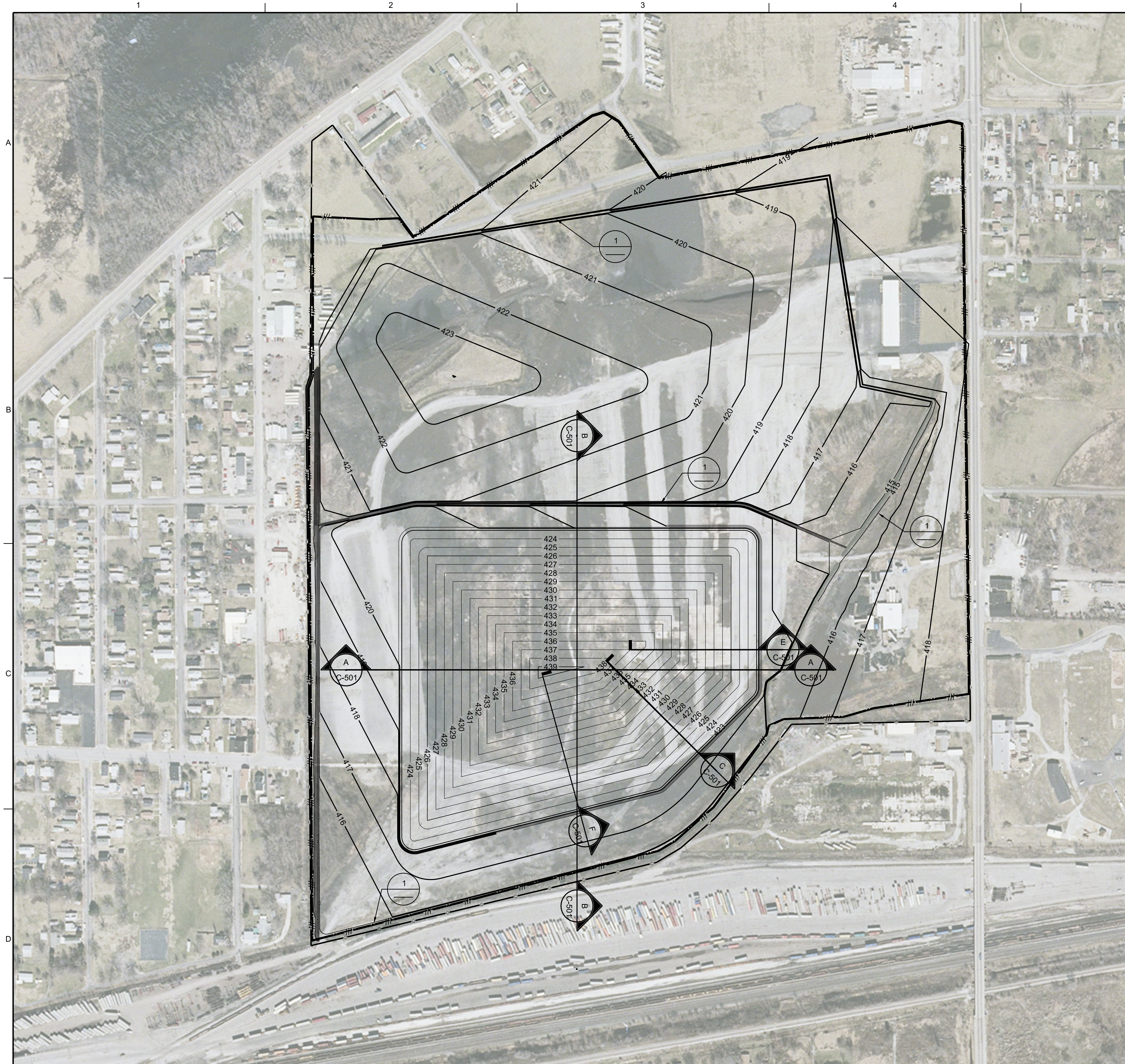
CIVIL

SITE RESTORATION
CLAY COVER

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

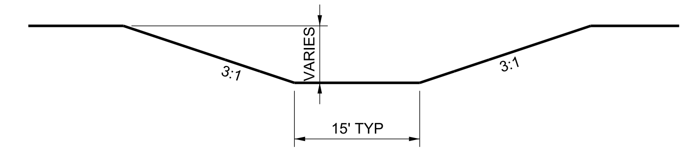
DATE	APR 2018
PROJ	687729
DWG	C-008
SHEET	10 of 13

DESIGN REVIEW



SEQUENCE OF CONSTRUCTION

1. REMOVE SLAG FROM FOOTPRINT OF CONSOLIDATION AREA, GENERAL FILL STOCKPILE AND CLAY STOCKPILE. PLACE SLAG ON EXISTING SLAG STOCKPILE OR IN ADDITIONAL STOCKPILE AREA FOR SLAG. SEE DWG C-004 AND C-005.
2. EXCAVATE CONSOLIDATION AREA TO DESIGN GRADES. SEE DWG C-005.
3. STOCKPILE EXCAVATED MATERIAL IN GENERAL FILL STOCKPILE AND CLAY STOCKPILE.
4. PLACE STOCKPILED SLAG IN CONSOLIDATION AREA. SEE DWG C-006.
5. EXCAVATE SURFICIAL SLAG FROM REMAINDER OF SITE AND PLACE IN CONSOLIDATION AREA.
6. PLACE CLAY COVER OVER CONSOLIDATION AREA. SEE DWG C-007.
7. PLACE REMAINDER OF STOCKPILED CLAY AS GENERAL FILL TO DESIGN GRADES. SEE DWG C-008.
8. **PLACE TOPSOIL OVER ENTIRE SITE AND CONSOLIDATION AREA TO DESIGN GRADES AND REMEDIATE.** SEE DWG C-009.



1 TYPICAL DITCH SECTION

NTS

N

0 200 400 600

1"= 200'

NO.	DATE	REVISION	BY	APVD

DSGN	DR	CHK	APVD
T OXLEY	D SCHAUER		

US EPA

OLD AMERICAN ZINC SUPERFUND SITE

FACILITIES AREA DESIGN

FAIRMONT CITY, ILLINOIS

ch2m:

CIVIL

PROPOSED RESTORATION AND TOP OF CONSOLIDATION AREA GRADES

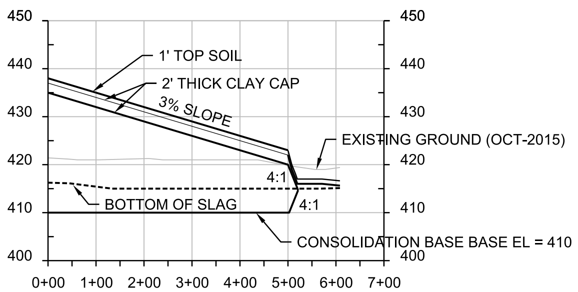
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

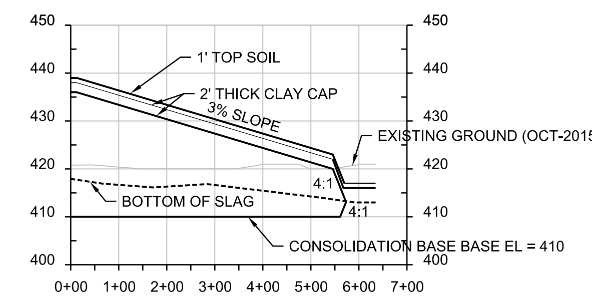
DATE	APR 2018
PROJ	687729
DWG	C-009
SHEET	11 of 13

DESIGN REVIEW



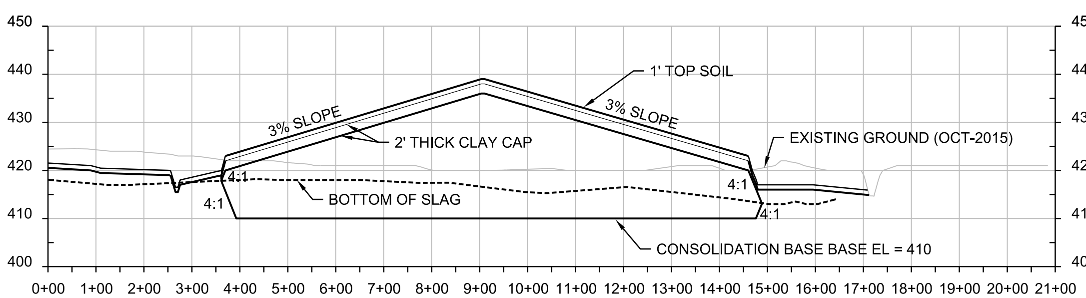
SECTION C-C

NTS



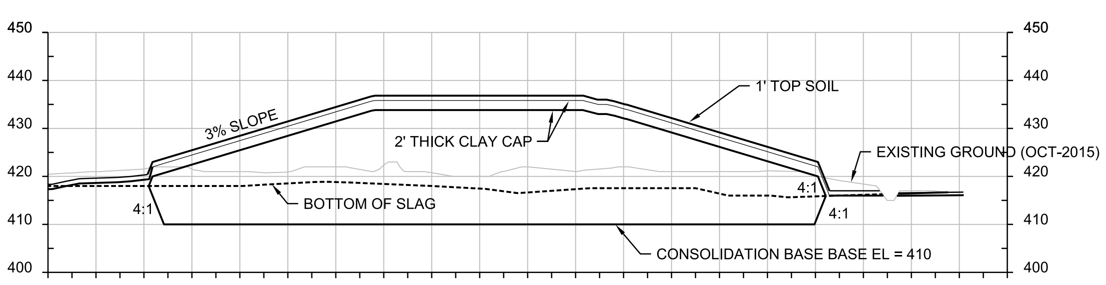
SECTION E-E

NTS



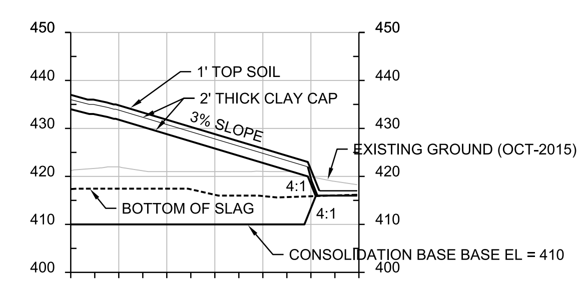
SECTION B-B

NTS



SECTION A-A

NTS



SECTION D-D

NTS

N

0 200 400 600

1"= 200'

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY DR D SCHAUER CHK APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m

CIVIL

CONSOLIDATION AREA SECTIONS

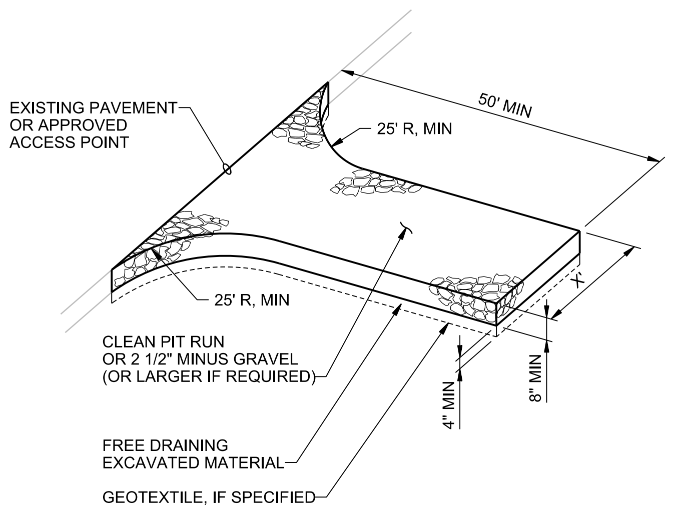
VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

DATE	APR 2018
PROJ	687729
DWG	C-010
SHEET	12 of 13

DESIGN REVIEW



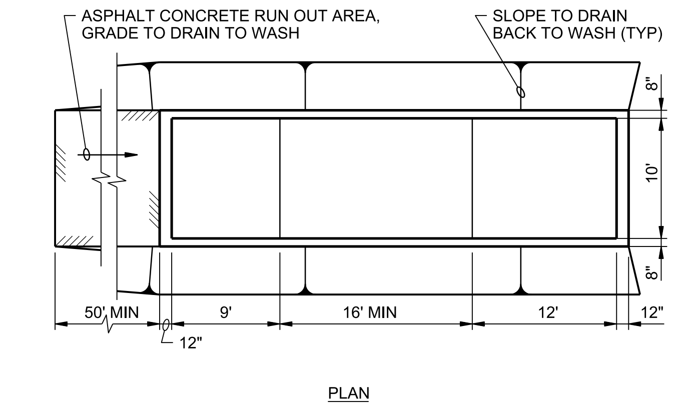
NOTES:

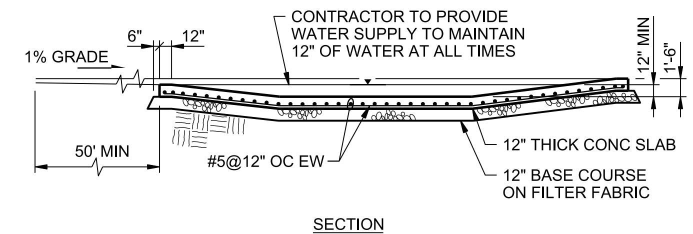
1. ADDITIONAL GRAVEL MAY HAVE TO BE ADDED PERIODICALLY TO MAINTAIN PROPER FUNCTION OF THE PAD.
2. REMOVE GRAVEL ENTRANCE AND REPLACE WITH NEW BASE COURSE PRIOR TO COMPLETION OF ACCESS ROAD.

GRAVEL CONSTRUCTION ENTRANCE

NTS

3125-130





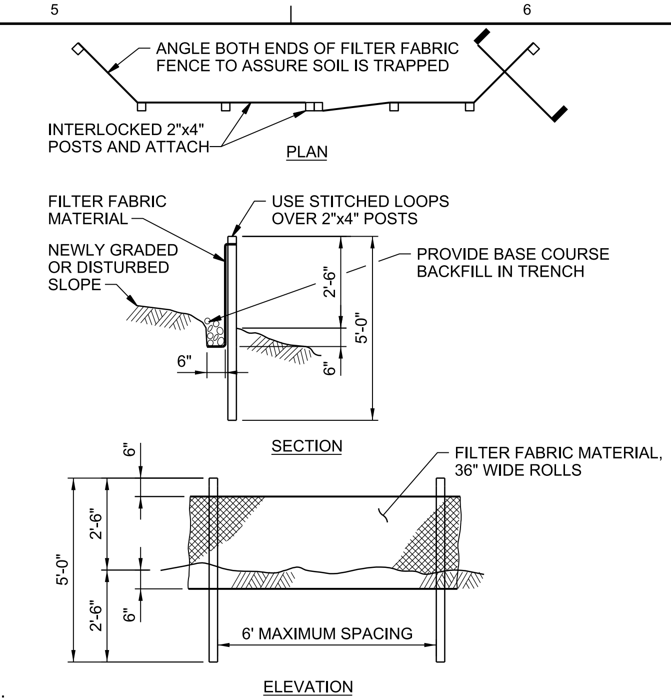
NOTE:

CONTRACTOR TO REMOVE ACCUMULATED SEDIMENT FROM WHEEL WASH, MAY BE PIPED TO AN APPROVED SEDIMENT TRAP.

WHEEL WASH

NTS

3125-135



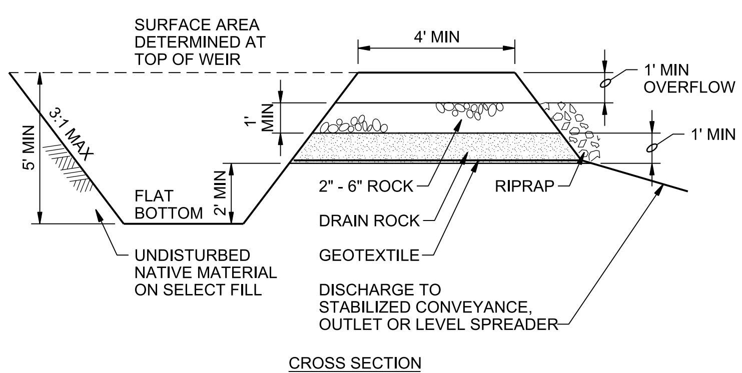
NOTES:

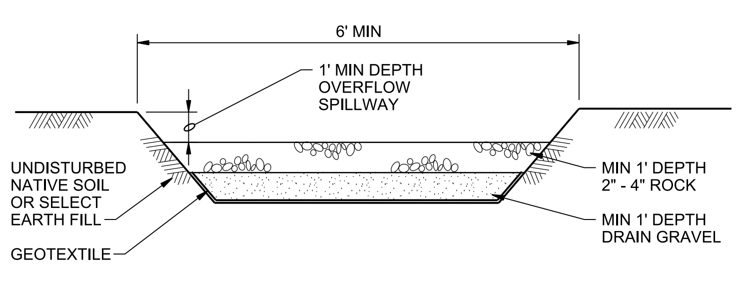
1. BURY BOTTOM OF FILTER FABRIC 6" VERTICALLY BELOW FINISHED GRADE.
2. 2"x4" DOUGLAS FIR OR STEEL FENCE POSTS.
3. STITCHED LOOPS TO BE INSTALLED DOWNHILL SIDE OF SLOPE.
4. COMPACT ALL AREAS OF FILTER FABRIC TRENCH.

SEDIMENT FENCE

NTS

3125-165





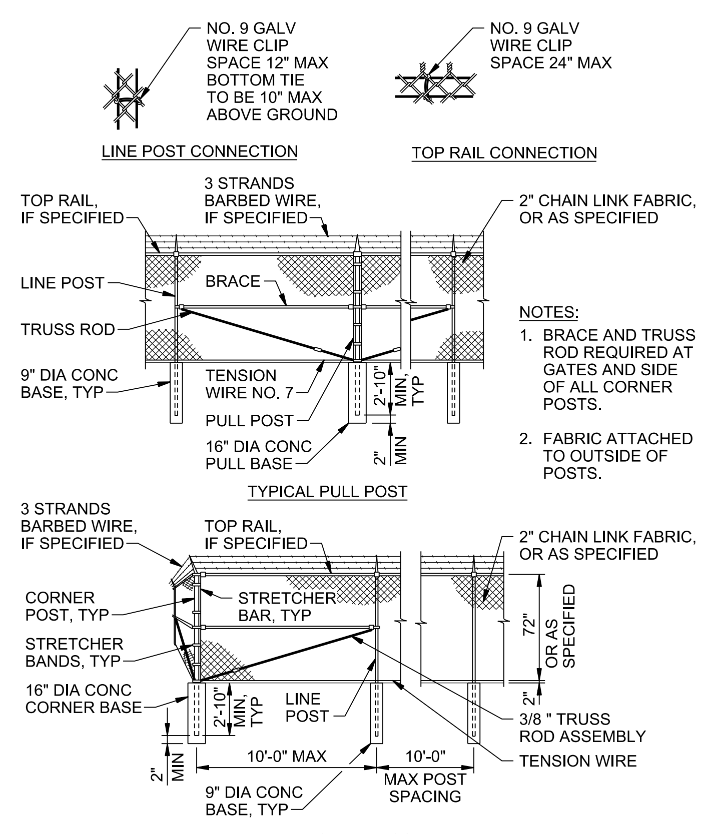
MAINTENANCE STANDARDS:

1. SEDIMENT SHALL BE REMOVED FROM THE TRAP WHEN IT REACHES 1 FOOT IN DEPTH.
2. ANY DAMAGE TO THE TRAP EMBANKMENTS OR SLOPES SHALL BE REPAIRED.

SEDIMENT TRAP

NTS

3125-175



NOTES:

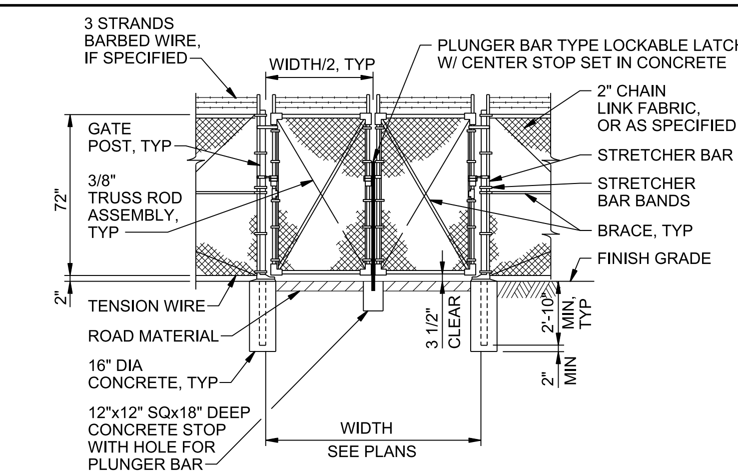
1. BRACE AND TRUSS ROD REQUIRED AT GATES AND SIDE OF ALL CORNER POSTS.
2. FABRIC ATTACHED TO OUTSIDE OF POSTS.

CHAIN LINK FENCE

NTS

X

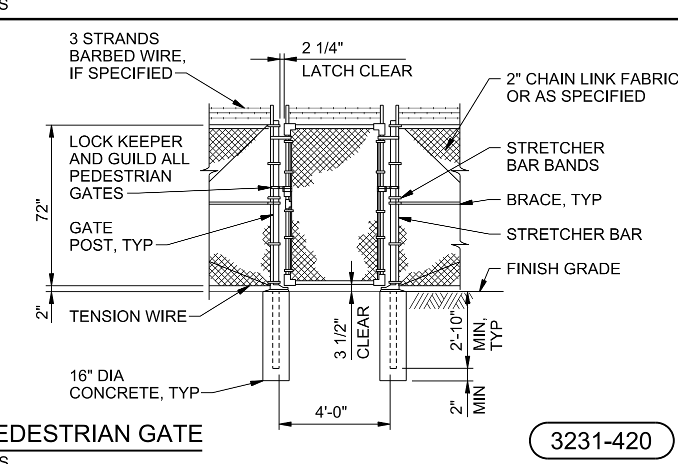
3231-410



DOUBLE SWING GATE

NTS

3231-415



PEDESTRIAN GATE

NTS

3231-420

NO.	DATE	REVISION	BY	APVD

DSGN T OXLEY | DR D SCHAUER | CHK | APVD

US EPA
OLD AMERICAN ZINC SUPERFUND SITE
FACILITIES AREA DESIGN
FAIRMONT CITY, ILLINOIS

ch2m.

CIVIL

DETAILS

VERIFY SCALE

BAR IS ONE INCH ON ORIGINAL DRAWING.

0 1"

DATE	APR 2018
PROJ	687729
DWG	C-011
SHEET	13 of 13

DESIGN REVIEW